

Railway Mechanical Engineer

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At the end of the present volume of the *Railway Mechanical Engineer*, which closes with this issue, only a sufficient number of indexes will be printed to supply the direct requests for copies, received from our subscribers. If you wish to have a copy, therefore, don't fail promptly to advise our New York office, 30 Church street, New York.

Elsewhere in this issue is a partial report of the Chief Interchange Car Inspector's and Car Foremen's convention

Car Inspectors' Convention

Owing to delay in receiving the stenographic report of the proceedings they could not be published in the November *Railway Mechanical Engineer*, but the entire discussion of interchange rules and one of the papers are included in this issue. We expect to publish the rest of the papers together with the discussion which followed each and the discussion of billing rules in the January number. Car inspectors and car foremen should study the proceedings of their association carefully, and while those unable to attend the convention can never really get the inspiration which comes from meeting fellow workmen face to face and discussing mutual problems, the next best thing is to study the discussion and profit by the suggestions made. They have an important bearing on the safe and efficient operation of over two million freight cars in the United States alone.

The large percentage of railroad revenues that must be expended by every road for the maintenance of its locomotives

Competition— is well known by all officers and is doubtless recognized also to a considerable extent by the mechanics whose duty it is to make the actual repairs.

The whole organization of the mechanical department and its activities center around the work of equipment maintenance. Shops, enginehouses and car repair facilities are provided largely for maintenance purposes. While it is unnecessary to direct attention to the relationship between the magnitude of expenditures for equipment maintenance and the general cost of operation, there is an aspect of the situation that is of interest to every man in the mechanical department; that is, the connection which exists between the design of cars or locomotives, and the facility with which repairs can be made, and the costs for maintenance. The common practice of placing orders only when the need for new equipment is so urgent that the quickest possible delivery date is the factor given the greatest attention does not always admit of the closest attention being given to details of design. As a result, the cost of maintenance is ever after

more than it might have been had the design been a better one. The men who have to repair a broken locomotive frame or maintain poor foundation brake rigging on a freight car are in a position to find out and recognize the mistakes that are made in what was possibly a hurriedly prepared design. These are points often seen even more clearly by the men in the shops or on the repair tracks than by the mechanical engineer or draftsman. The vital question is what can be done to secure better designs and thus reduce the time that cars and locomotives are held out of service on repair tracks or in shops while repairs are being made. The facility with which repairs may be made or a reduction in the frequency of repairs will greatly reduce costs. The importance of the matter is such that the *Railway Mechanical Engineer* is offering a first prize of \$50 and a second prize of \$35 for the two best articles received on or before February 1, 1924, telling of what has or can be done to secure improvements in design to facilitate a reduction in the cost of maintenance. Additional articles which may be used in our columns will be paid for at space rates.

The judges had unusual difficulty in deciding upon the winners in the apprentice competition, which closed September 1,

The Apprentice Competition

because of the uniformly high grade of the articles submitted and because of the widely varying viewpoints of the young men. For instance, there were several entries from Canadian railways where "old country" methods are apparently being followed in turning out thoroughly trained mechanics—five years being the time of indenture. Then there were a number of articles from the Santa Fe, where an apprentice system has been developed far in advance of that on most roads, due to the abiding faith in young men and the vision and optimism of John Purcell and Frank Thomas. Many other articles were received from roads with standards of apprentice training extending from those of the Santa Fe down to no standards at all, except possibly that something called by the name of an apprentice course is being maintained. The judges hardly expect all of our readers to agree with their decisions—there is too great a diversity of viewpoints, and the judges had difficulty in reconciling their own viewpoints. One thing is certain, however, and that is that the young men make some mighty constructive suggestions.

The first prize of \$35 was awarded to W. L. McGowan, machinist apprentice, Atlantic Coast Line. The second prize of \$25 was awarded to Harrison Lee Price, Atchison, Topeka & Santa Fe, Ft. Madison, Iowa. Many of the other contributions were of an exceedingly high grade and will be reproduced in whole or in part in forthcoming issues. The judges, however, recommended that honorable mention be made of the following: Earl D. Austin, machinist apprentice, Chicago, Milwaukee & St. Paul, Galewood, Ill.; F. O. Robinson, machinist apprentice, Canadian National Railways, Fort Rouge shops, Winnipeg, Man.; John M.

Wylie, boilermaker apprentice, Erie Railroad, Jersey City, N. J.; Clifford Strock, machinist apprentice, Pennsylvania System, Sunbury, Pa.; and Elwood Thalman, carman apprentice, Atchison, Topeka & Santa Fe, Albuquerque, N. M.

In all, 62 articles were submitted in the competition. These came from 20 railroads and from 39 shops. One could not help but be impressed, after reading the manuscripts, with the fact that the mechanical departments have some mighty fine material in training. The question is whether mechanical officers and foremen, with the possibility of making a strong and lasting impression for good upon these boys at a critical age, will make the best of their privilege and opportunity. A careful reading of some of the articles would seem to indicate that some roads, at least, are falling far short of the mark. What can be done to awaken them? For at least a quarter of a century this publication and its predecessors have kept pounding at this question—in season and out of season. We have brought every possible argument to bear. We have described and commented upon the best and most advanced practices of apprenticeship wherever we could find them. You could not accuse us of being impractical, of being visionaries and theorists, for we pointed to real, practical results. It is true that there has been some response—that some substantial progress has been made. But how pitifully slow the progress has been when we consider how much has been at stake!

It is not the small roads with limited resources that are failing—some of them are doing splendid work. Some of the great roads with large resources, and with everything to gain by developing better trained and more loyal employees, are at fault. It would be too strong to say that they are sound asleep, but, on the other hand, they are far from being fully awake to their responsibilities and opportunities.

We have tried to get constructive suggestions from the apprentices themselves in order to break through the walls of indifference. The boys have rallied to our call. They have supplied us with some mighty good ammunition. We shall start to shoot it in our January issue.

The failure of the proposals to adopt the Car Construction Committee's car designs as the recommended practice of the

Standard Cars Still a Live Issue

Mechanical Division to carry the necessary two-thirds votes of the membership, was announced by the Mechanical Division on November 22. On the proposition to adopt the designs for single-sheathed box cars, the vote stood 1,061 yes, 650 no, and 1,060 not voting. Similarly, for the double-sheathed car designs the vote was 1,028 yes, 953 no, and 790 not voting. On the three classes of Type W truck designs, the vote was 986 yes, 995 no, and 790 not voting; while on the Type Y designs, the vote was 1,112 yes, 869 no, and 790 not voting. The votes in all cases are on the basis of one for each one thousand cars owned or controlled, and two-thirds of the votes cast are required in favor of the proposals for their adoption as recommended practice. The General Committee has announced that the real objections to the designs have been reduced to a few items and that the propositions have been transmitted to the Committee on Car Construction for review and return to the General Committee by December 7. The General Committee then plans to submit the modified recommendations to the membership at a special meeting for further discussion followed by another letter ballot.

The *Railway Mechanical Engineer* has maintained that these designs should be adopted and sees no reason for changing this position. It further believes that little can be gained by referring the whole matter back to a new committee, which would have to start practically at the beginning and develop new designs for submission to the Mechanical Division.

But, with a knowledge of the principal objections to the designs as they now stand, obtained as a result of the letter ballot, the committee should be in a position intelligently to meet the desires of the required majority of the voting members without impairing the integrity of the fundamental designs which they have developed. Considering the apparent lack of complete understanding of the designs indicated by the number of members not voting, the action of the General Committee in not dropping the matter following the results of the letter ballot but in pushing it forward for further consideration in modified form at a time while the interest in the subject is lively, is worthy of the utmost commendation.

The judges have had great difficulty in deciding upon the prize winners in the Shop Management Competition, which closed in September. Among the papers presented were several splendid ones, especially when considered from the viewpoint of constructive suggestions.

The first prize of \$75 has been awarded to Frank J. Borer, freight shop foreman of the Central Railroad of New Jersey, at Elizabethport, N. J. Mr. Borer is known to the readers of the *Railway Mechanical Engineer* because of his participation in competitions and the preparation of a number of special articles during the past 12 years or more. The second prize of \$50 has been awarded to M. H. Williams. This, also, is a familiar name to readers of the *Railway Mechanical Engineer* because of the splendid articles which have appeared under that signature in recent years; the article on Standardization of Locomotive Repair Parts in the June issue of this year is a noteworthy example. It is only fair to say that the name is a *nom de plume*, the author preferring for certain reasons not to write under his own name. These prize articles, as well as several of the other contributions which are of high quality, will be published during the coming months.

Railroad officers may be roughly grouped into two classes with respect to their attitude toward the objective of locomotive maintenance expenditures. On the

Fuel Economy and the Mechanical Department

one hand there are those who look upon these expenditures as a necessary evil that should be reduced to a point below which there will be an actual failure to operate. In its extreme this attitude gives little consideration to the locomotive as the factor responsible for the creation of one of the largest items of operating expense through its consumption of fuel, but considers it only as a machine, which, so long as it will move trains with a reasonable degree of reliability, is completely fulfilling its function. On the other hand are those who regard maintenance expense as something in the nature of an investment, from which more should be obtained than the mere ability to keep the road in operation. These officers are willing to increase maintenance expenditures beyond the dead line fixed by the requirements of reliability if for each additional dollar expended more than a dollar can be saved in some other of the numerous operating expense accounts.

That the latter attitude is essential to real fuel economy is clearly suggested in the prize-winning paper in the International Railway Fuel Association contest, which will be found on another page of this issue. Point is given to the suggestion by the specific case which is cited, wherein the special attention to roundhouse maintenance which was received by a certain locomotive while in the hands of a regularly assigned crew had a noticeable effect on the fuel bill for months after the locomotive had been placed in pool operation and had ceased to receive more than the average attention from the mechanical department.

This example is a striking bit of evidence that a high standard of maintenance is effective in increasing fuel economy. But before a practical program for the promotion of fuel economy can be adopted by the mechanical department, there must be specific knowledge of the extent to which such an improvement may be effected by a given increase, for instance, in the amount of effort expended in the elimination of air leaks into the front end, or the frequency with which boiler tubes are blown out or piston and valves pulled for the renewal of packing rings. These and other defects are frequently reported day after day without attention and the officer or supervisor responsible for this condition probably in no case can cite facts on the basis of which he can prove that any saving in maintenance which he is effecting thereby, is not actually a loss to his company. On the other hand, were he boldly to attack the situation and effect a marked increase in his standards of maintenance, would he be any better able to bring up definite facts to prove a net saving in case his policy were subjected to criticism?

Even on railroads where the importance of fuel economy is recognized to the extent that it is entrusted to the supervision of a fuel department, there is much working at cross purposes in this respect. Mechanical officers, being judged largely by their maintenance costs, are naturally interested primarily in the one side of this question and in many cases the fuel department confines its viewpoint too closely to the other side. They therefore become partisans and the course actually taken depends far more on the personal ability of one or the other of the officers to have his way than upon the economics of the situation with which they are dealing.

The facts required for a common sense settlement of this question should not be difficult to obtain. If accurate statistics of unit expenditures for maintenance and fuel consumption are not available a few simple tests to determine the cost and net results of varying standards of maintenance in the important items affecting fuel economy would provide the basis for the exercise of sound judgment in fixing the final policy and would bring about a spirit of intelligent co-operation where antagonism is now too frequently in evidence.

Most men hesitate to ask questions about their work, either because of fear of displaying ignorance or from pure mental laziness. Whatever the cause, the problem of increased personnel efficiency is largely solved when employees can be interested in what goes on around them to the extent of asking questions. Not

The Value of Questions

only are experienced employees benefitted by asking questions but new men can thus acquire knowledge rapidly and be of more value to themselves and to the company which employs them.

Realizing these facts, the Chicago, Burlington & Quincy has recently evolved a plan whereby questions can be asked anonymously by car department employees and submitted to a special committee which answers them, subsequently publishing questions, answers, and in most cases the reasons for the answers, in monthly educational bulletins distributed to the entire department (except laborers). While to date this plan has been applied only in the car department the educational committee has received and answered 70 questions indicating the interest already aroused, and arrangements are now being made to carry on this work in the motive power department.

Briefly the plan consists of distributing post cards among the men, to be filled out with questions regarding any phases of the work which puzzle them and then deposited in a question box at the local shop point. The men's names are not shown, and this brings out many questions which would not otherwise be asked. All questions are referred to a

committee of four general car foremen and car inspectors, and the answers, therefore, are made by practical men, expressed in language which shop men can readily understand. Both the questions and answers are printed in bulletin form, perforated so that they can be kept on file and later bound. Each question is numbered and followed with the letter A, B, C, D, or E to indicate whether it relates to air brakes, safety appliances, coach cleaning, shop practice, trainyard inspection, etc.

At several points shop meetings have been arranged for the purpose of discussing the questions and answers, and these meetings are encouraged as they have proved of material value not only to the workmen but to the supervision on account of suggestions brought out. This question and answer educational plan is decidedly interesting and holds much of promise as a means of affording mechanical department employees a better understanding of their work.

Grinding in Railway Shops

The rapid development of the grinding machine as a shop machine tool has brought about many radical changes in shop methods. There is no question but that economy and superior results can be obtained by grinding on many classes of work. It has enabled a number of shops to standardize and to institute real production methods and to eliminate the old and expensive methods of doing a job at a time. A locomotive has from 15 to 30 valve motion pins and bushings ranging in size from 1 1/4 in. diameter and 4 in. long to 3 in. in diameter and 8 in. long, and from two to eight side rod knuckle pins and bushings and a large number of other motion parts. The customary method of repairing these parts has been by turning, filing, emery papering, etc. A large number of railway shops now make use of the gap grinder for finishing piston rods. In some shops the bearing surfaces of valve motion pins are ground to standard diameters at the time of manufacture, and the companion bushings are internally ground to plug gages. These parts are made in lots ranging from 100 to 1,000. These examples are typical of the kinds of work on which the grinding machine should be used, wherever the possibilities of standardization insure production volume. Decided savings in time and money have resulted in shops where this has been carried out. The utilization of grinding machines in the smaller shops is necessarily limited on account of the usual practice in obtaining supplies from the central or main shops. This concentration of manufacturing at the large shop, however, increases the possibilities for the grinder at these points.

What Our Readers Think

Three-Cylinder Locomotives on the Reading

PHILADELPHIA, Pa.

TO THE EDITOR:

The description in the November issue of the three-cylinder engine for the New York Central calls to mind the engines with which the Reading was experimenting a dozen years ago. The aim with these engines was different from that of the New York Central, but they gave a good account of themselves. They were built for passenger service, the aim being to get an engine to run nicely at extreme speeds. This is a valuable characteristic on some of the Reading lines, where the speed limit is 90 miles an hour, and the

enginemen have to be called down from time to time for exceeding it considerably.

There were three of these engines, two Atlantics and one ten-wheeler. One Atlantic was new, the other and larger was rebuilt from a two-cylinder engine as part of an extensive campaign of rebuilding all the fast power into three-cylinder engines. The ten-wheeler was new. As the new three-cylinder engines were different in general dimension from anything the Reading then had, and were also the first passenger engines to be equipped with piston valves, a companion two-cylinder Atlantic and ten-wheeler were built, with cylinders to give about the same tractive force as the three-cylinder engines. The two-cylinder engines were about 7,000 lb. lighter than the three-cylinder.

The machinery of these engines impressed the observer as being very fine. The outside cylinders drove on the second pair of driving axles, and had Walschaerts valve gear, the inside cylinder drove on the front axle and had a Joy motion. The crank axle was made in a single piece. It was possible, and expedient, to make the stroke only 24 in., which, of course, helped to make the engines fast running. On account of their experimental nature all the workmanship on the engines was excellent.

Comparative tests of the two- and three-cylinder engines seemed to show a slight economy of fuel on the part of the latter, about six per cent. Any figure showing the fuel consumption of individual runs in this service is open to suspicion, as the engines burned anthracite egg. It is possible to make long runs with this fuel without putting a scoopful of coal into the firebox from one end of the trip to the other. Under these conditions the figures arrived at depend on the testers' ability to judge the fire at the start and at the finish. One of these engines had the reputation of being able to handle a very hard train from Philadelphia to Jersey City without doing any firing on the run. There seemed no doubt that these engines were easier on the fire than were the corresponding two-cylinder engines. This was in part due to the easier action of the exhaust, and in part to the lessened swaying of the engines. The fire was not torn up so much, nor was there the tendency to shake the coal away from the side sheets into the center of the firebox. Any decrease in fuel consumption would seem attributable to this cause, or to lessened back pressure due to more favorable action of the exhaust nozzle.

The engines ran well in service, further designs were prepared and preparations made to rebuild the lighter power, but they would not stay running. Sooner or later they would have a hot driving box and have to be taken out of service. It was said that the journal would actually get red. They would not run on grease, and a force feed system of lubrication was installed. It was the general impression that the trouble arose from the more uniform turning moment of the three-cylinder engines, as the shafts were not slapped back in the boxes as in a two-cylinder engine, and the lubricant did not have so much chance to work around. This trouble with the driving journals was unique; no two-cylinder engine showed it.

Once the journal had been burned and re-turned on that account, or the engine put through the shop for general repairs, there was trouble getting it running again. First one and then another box would run warm, and most likely some of the journals would have to be re-turned again before the engine would finally be broken in. It was always a matter of several days, or even a week, light running before the engine could be trusted with a train. It seems that there might have been less trouble of this sort if it had been anticipated in the original design.

The engines had the regular form of driving boxes, with a bearing only on the top. The load on a driving journal, particularly when working hard, comes pretty well down toward the lower edge, and the oil film must have trouble in

building up the needed pressure in the small space allowed. With the ordinary engine, with the shaft knocking back and forth at each revolution, this does not matter, as the oil has plenty of chance to flow in under no pressure. But with these engines it did not get this chance. If the bearing had been made to cover part, or all of the lower half of the journal, much better results could have been expected as the actual unit pressure would have been much lower. The oil pump also did not seem to give the best results. It pumped only a small quantity of oil at each stroke, being driven off the valve gear, and the feeling was that the engine ran a long way before the oil started to get on the bearing. This pump, of course, needed some looking after, and in the hands of a strange engineman was not likely to get the proper attention. It is hardly necessary to say, since oil is the thing dearest to a railroad company, that oil for these bearings was given very grudgingly. In this connection there was a curious thing. When breaking in one of these engines it seemed almost imperative to put a lot of tallow in the driving box cellars. This seemed to make them run cool where the regular oil never would.

Failure of the crank shafts got to be rather common, and this, together with the trouble of breaking the engines in, and the constant hot boxes, made their cost of maintenance rather high. The man responsible for their introduction left just when the experiment was well under way, and the rebuilding of more engines or the building of further new ones was not carried on. After further changes in the department, about the time that new cylinders would have ordinarily been applied—this company puts in new cylinders rather than attempt to bush down the old ones—the engines were rebuilt to correspond with the two-cylinder engines. There is no doubt, however, that in many respects they were the finest engines the company had.

GEORGE L. CLOUSER.

College Men in Railroad Shops

PITTSBURGH, Pa.

TO THE EDITOR:

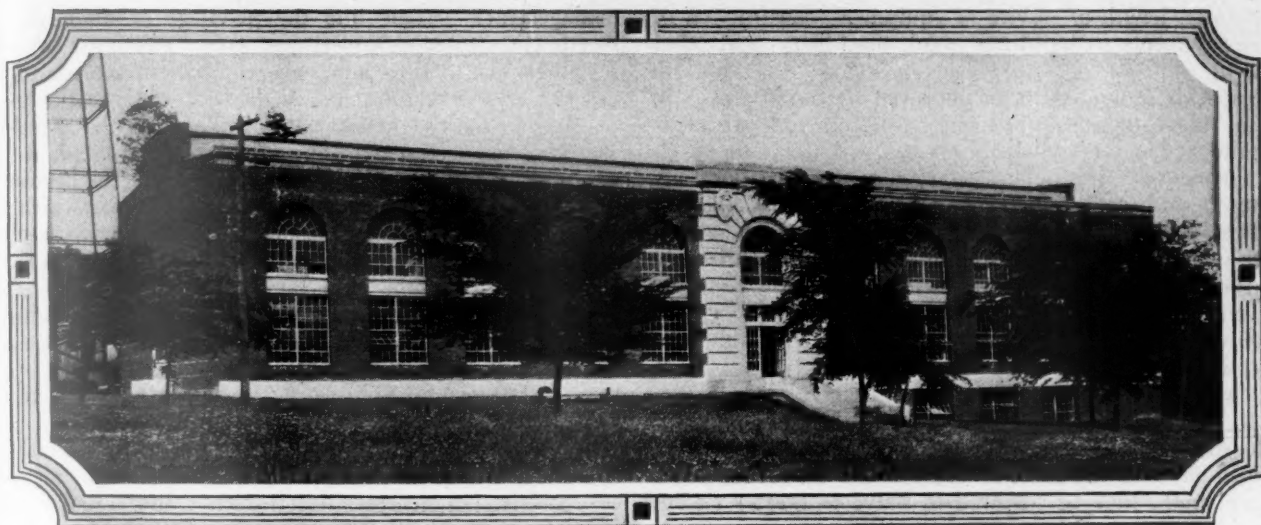
As a special apprentice I was very much interested in Alfred H. Burnham's article in the October number of your magazine, page 677. In my opinion Mr. Burnham places too much stress on the social features of his training, the "rubbing elbows with industry," and not enough on the practical engineering training he is receiving. The absorption of knowledge pertaining to the parts of locomotives, freight cars and passenger coaches and the various methods by which they are made and put into their respective places, is the biggest opportunity the shops offer him; because so long as he is earning his livelihood in the railroad world he may have plenty of positions that will never bring him into contact with the labor question, but he will always have need of some portion of his shop experience.

Likewise I think his ideas concerning the way the company can best use his services when his "time has been served" are rather vague. In my estimation the special apprentice is of use to the company in any one of three classes of service. If he is most interested in the mechanical features of the shops, as, for instance, the construction of locomotives, he belongs to the engineering class. If, on the other hand, his ability lies in the elimination of wasteful methods of shop production, he should be graded in the efficiency class. Finally, there is the executive or managing class, in which he should be placed if he shows any aptitude for administration.

The company should transfer the graduate special apprentice from one of the above classes of service to the other until it finds out the one in which he shows the most ability.

SIDNEY H. PRATT.

Special Apprentice, Baltimore & Ohio, Glenwood, Shops.



Power Laboratory, Mechanical Engineering Department, The Pennsylvania State College

Broader Training Needed for College Graduates

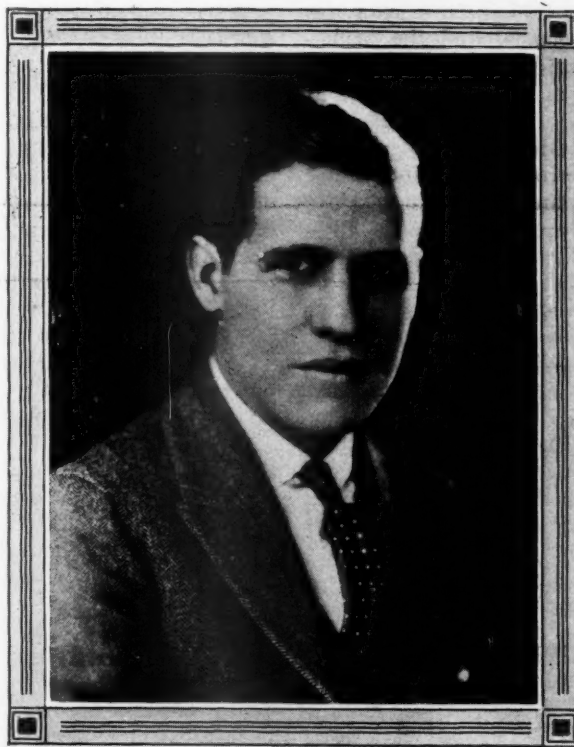
Should Acquire a General Knowledge of Other Departments and Phases of Railroad Work

By E. B. Fields*

Special Apprentice, Atchison, Topeka & Santa Fe, Albuquerque, New Mexico

WITHIN the past few years the railroads have evinced an ever increasing willingness to employ college graduates in all departments. At the same time there has been a constant enlargement of facilities and advantages for utilizing and developing the accomplishments and training acquired in college. Consequently, the railroads today offer to the college man a field of unlimited opportunity. There are places to be had in all branches of the service for those men who are willing to make the most advantageous use of their knowledge of science and theory by adding to it a knowledge of practical things acquired in actual service.

To be more specific, the Santa Fe, in whose service the writer is engaged, offers unusual opportunities, particularly to those men who are mechanically inclined. This railroad has a splendid course of intensive training, intended to convey to the man a thorough and practical knowledge of the work required to keep the motive power and rolling stock in good condition.



E. B. Fields

The course is essentially a shop course, consisting of actual work at all of the important operations involved in the construction, maintenance and repair of locomotives and cars. It includes one year of machine work, one year of locomotive erection, and one year of diversified experience in the departments directly connected with the work of the first two years, and in addition, car work, road work and special work, such as tests, etc.

A close personal interest is taken in the man to see that he acquires, to the full extent of his ability, that knowledge of the work which will make him a useful part of the organization—an asset to the road. Most of the railroads have that idea in view when they attempt to train the college man in practical things.

Training Not Broad Enough

There are, however, one or two essentials lacking. While the man acquires a thorough general knowledge along mechanical lines, there is little opportunity to learn about the other departments of the road, such as operating, financial, maintenance-of-way, etc. While he is obtaining the fundamentals of maintenance of equipment, he learns little or nothing of such things as determina-

* Mr. Fields was graduated from Pennsylvania State College in 1922; he took the course in Railway Mechanical Engineering. This article received honorable mention in the special apprentice competition which closed September 1. The first prize article was published in the November issue, page 737.

tion of costs, length of service of equipment, construction of and improvements in buildings, road, machinery, and other equipment.

The special course could be improved by modifying it so as to include sufficient time spent in the other departments to acquire a general knowledge of the inter-relation of all the departments. It is not necessary that the man familiarize himself with the financial statistics of the road, but he should have some idea of the cost of repairs and what revenue is expected from the rolling stock. This is the only method of classifying the equipment and is the basis of future additions and betterments.

This additional training need not be included in the apprenticeship period served by the college men. In fact, it might be a good plan to arrange that it be optional with the man; if he wishes to acquire the additional experience, let him do so; or even better, the option might be allowed to those men showing the greatest aptitude during their course. The man might thus be inspired to strive to greater efforts during his apprenticeship.

Take Him Into Your Confidence

In addition, would it not be a good thing if the man were allowed some part in the organization—a voice in the local

management? Allow him the privilege of attending such meetings as foremen's meetings, safety meetings, betterment meetings, etc. Allow him some freedom in the use of those powers of observation and methodical organization, which he supposedly has developed in college, to the solution of the problems of development and enlargement of plant facilities and increase in production. His ideas might result in important advantages to the particular road of which he is a part. It is not intended that he should have a vote in the determination of policies; but since the main idea of the training is to fit the man for a position of responsibility, managerial and executive, it would seem wise that he should receive some insight into such matters along with the other training. Even though some of his ideas might be contrary to the general policies, he could be shown where he is at fault.

How may the college man's services be utilized to most advantage by the railroad? That is a question that cannot be answered in general. It is rather individual personal characteristics which determine a man's ability to render service. But by obtaining the additional training, along with the general knowledge of things mechanical, he should be most valuable by specializing in the branch at which he is the most apt, or in which he is the most interested.

Two Unique Experiments in Co-operation

The Employee Representation System on the Pennsylvania and the B. & O. Agreement with the Shop Crafts

TRANSPORTATION'S fundamental need—better relationships between the management and the men—was the major topic for consideration at the Sixteenth International Conference of the Transportation Department of the Young Men's Christian Association which was held at St. Louis, Mo., November 15-18. In connection with this part of the program two interesting addresses were made, covering important and unique experiments in co-operation which are now being made on a large scale. Co-operation as involved in the employee representation system on the Pennsylvania was described by E. T. Whiter, vice president of the Pennsylvania Railroad at Chicago, and the Baltimore & Ohio experiment with organized labor was touched upon by William H. Johnston, president of the International Association of Machinists. Mr. Whiter's paper dealt with mutual co-operation between the public, the employees and the owners, but space limitations have made it necessary to consider only that part dealing directly with co-operation between the employees and the managements. Abstracts of the addresses of Messrs. Whiter and Johnston follow.

Co-operation Through Employee Representation

By E. T. Whiter

Vice-President, Pennsylvania Railroad, Chicago

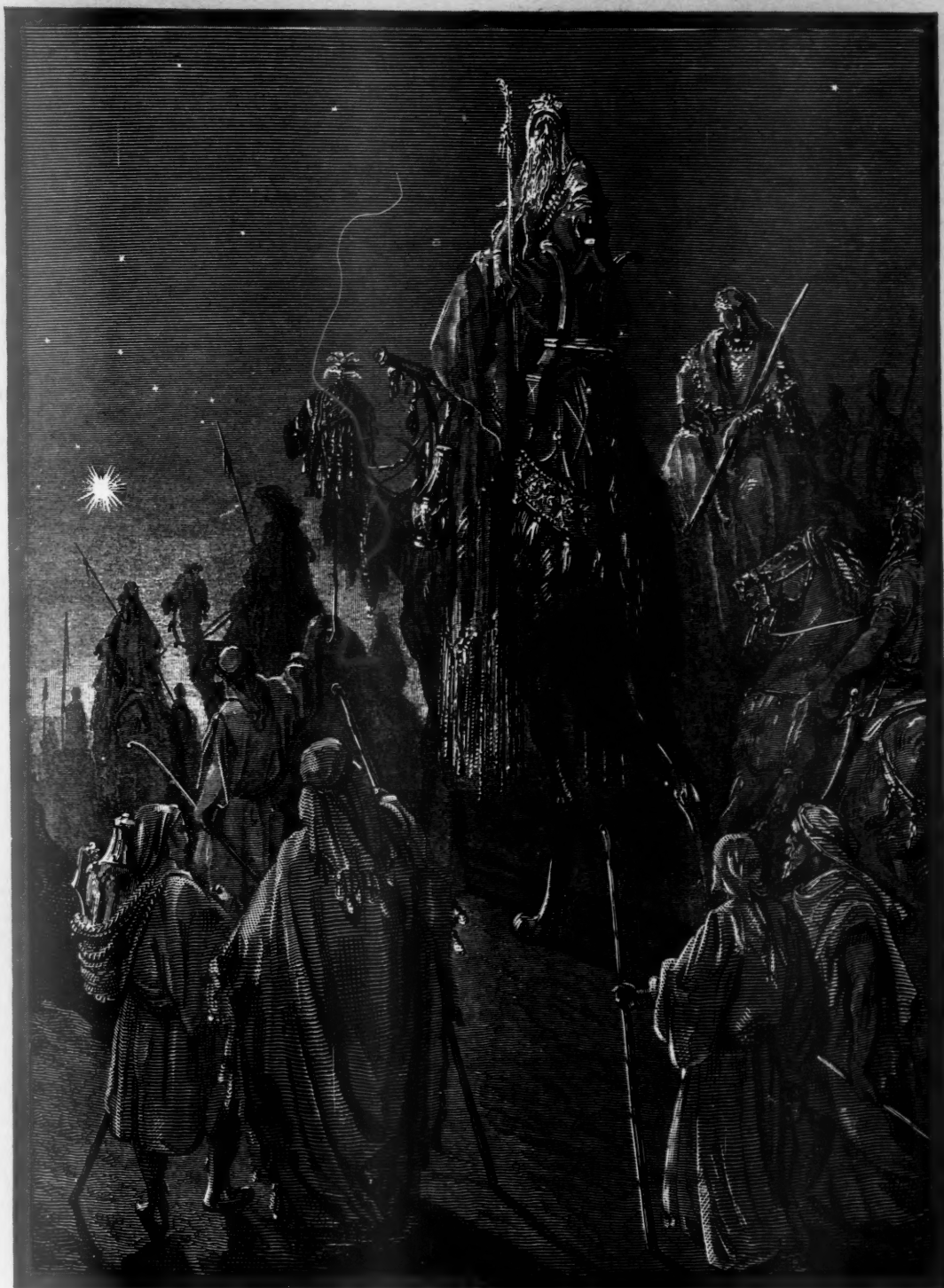
Railroad employees are responsible for the proper performance of their daily jobs. More so than in any other industry they largely supervise themselves. On the Pennsylvania Railroad, for instance, over 240,000 employees are scattered through 13 states and the District of Columbia. It is not possible to supervise every man. Yet, discipline is essential and the proper performance of the job depends in large measure on the employee's attitude toward it. Loyalty

alone is a great determining factor in making good or bad service.

Contented Employees a Big Asset

Railroad management realizes today that contented, healthy employees, mentally and physically, are one of the greatest assets a railroad can have. It recognizes the virtue of every man's aspirations to better living conditions, to an education for his children, and to independence in old age. And with these aspirations it sympathizes. They make for good citizenship, and in order to help in advancing these ends the Pennsylvania Railroad has established what is known as the Pennsylvania Railroad Employees' Provident and Loan Association. It is directed by employees, elected by employees; certain of the company's officers act as advisors, and the expense of conducting its operations is borne by the company. The fund enables employees to purchase stock of the Pennsylvania Railroad by cash payments or payments on the installment plan; it enables them to borrow money, if in need; it enables them to buy or build homes; it furnishes the opportunity to establish savings accounts; and it enables any who wish to do so to make deposits which will increase their pensions when retired, but wholly in addition to and entirely independent of the pension which the company gives to every employee without cost when he or she is retired at the age of 65 or 70 under the rules of the pension department. Officers and employees are alike mutual supporters of the Provident and Loan Association, which marks a decided step forward in a co-operative sense.

There is a growing desire on the part of both railroad managements and their employees to co-operate in all matters affecting their responsibilities to each other and to the public which they serve. Some of you are no doubt familiar in a general way with the success which we have had on the Pennsylvania in effecting a plan of co-operative action between officers and employees. Because it typifies in actual



And, lo, the star, which they saw
in the east, went before them
till it came and stood over where
the young child was.

When they saw the star, they rejoiced
with exceeding great joy."

Mat. 2.9, 10.

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practice the kind of co-operation that is essential in our business, let me give you a short outline of what it is and what it means.

A Closer Contact With Employees

For many years our management has been seeking closer contact with the employees, because it was recognized that the employee had a right to have and should have more than a mere "payday" interest in his job, and that he should have a voice in matters directly concerning his welfare.

As far back as 1907 the management realized that a carefully considered treatment of labor questions was necessary if the company wished to thrive as a successful institution. As an initial effort there was organized a committee of officers of the railroad, to sit as an appeal body of complaints filed with the general manager by the employees, and to act as counsel in advising the general manager as to the merits or demerits of particular cases.

We have, in the last three years, put in effect a comprehensive plan, the keystone of which is a joint committee for each general class of employees, which is the highest authority on the railroad in the determination of all questions affecting wages, working conditions and discipline. These committees are composed of an equal number of employee representatives, elected by secret ballot, and of management representatives. If a two-thirds vote cannot be had, the committee itself decides how a final determination shall be reached. No executive officer of the company, or the board of directors even, has veto power over the decisions of these joint committees.

When we first began to change our managerial attitude toward the problems arising in connection with letting the workmen help manage on questions concerning their interests, many questions arose as to what would be the general effect of the changed relationships as affecting supervision and discipline. Considerable hesitancy was shown on all sides by supervisory officers toward adopting industrial policies which might have a tendency to weaken that disciplinary control which must at all times be exercised by management, from the lowest to the highest supervising officer.

This new relationship between management and men on the Pennsylvania Railroad System has not meant abdication of purely managerial functions. It *does* mean that our employees, by slow, short steps, taken over a considerable period of time, beginning as early as 1907, have been given an increasingly larger voice in determining those questions which arise in the course of their daily work which involve differences of opinion between the management and employees.

Progress by Evolution

It has been realized by those who have participated in these discussions that the problem of the extent of employee participation must come by evolution, and progress only as changing conditions warrant. It meant that when the management began to invite the co-operation of the employees in the settling of questions in which they were closely interested and concerned, the employees themselves must be broad-minded enough, experienced enough and well enough balanced to recognize their responsibility in the handling of those matters. These results are being realized.

By some this new relation in industrial management is mistakenly called "industrial democracy"; sometimes it is called "a company union"; again it is called "letting the workman help you manage." But to us on the Pennsylvania Railroad it is known as "employee representation,"—and it is just that very thing, with all that the words imply. Management has not abdicated its right to promulgate any orders or instructions or to impose discipline in its best judgment, and management transmits the decision of reviewing committees, which it is in good faith bound to obey.

One of our officers, a superintendent, who has had many

years' experience as an officer of the company under the old regime, and who now meets committees regularly each month in accordance with the plan set up, when asked recently whether he would welcome a return of the old order, declared emphatically that under no circumstances would he want to return to the old order or relationship existing between employer and employee. He pointed out that never in all his many years' service as an officer had he ever experienced such willingness to co-operate, nor such actual co-operation between men and management, as was taking place today under our employee representation plan. He stated he hoped we would never go back to the old order, that men knew their officers better today, that officers knew their men better, and that they had more tolerance of one another's viewpoints, more sympathy for one another's problems, because management was acquainting the employees with its problems and vice versa, and out of it all was growing a bond of unified, friendly understanding such as had never before existed.

The Pennsylvania Railroad has brought about this co-operative spirit by dealing directly with its own employees, and regardless of the fact that the United States Labor Board, I am sorry to say, has endeavored unsuccessfully to do everything it could to force the Pennsylvania to recognize certain labor unions as representing its employees, and against the expressed wishes of the employees themselves.

Co-operation—Organized Railroad Labor's Contribution

By Wm. H. Johnston

President, International Association of Machinists

Co-operation is a word much used, but little understood. If I am boss, and want you to help me, I may ask you to "co-operate." But when you ask me to do something you desire in return, I tell you to put on your hat and shut the door from the outside. This is not co-operation. It may have the "operation," but it doesn't have the "co." Co-operation implies equality on both sides. It is not a matter of charity, it is a matter of mutual work for mutual advantage.

Two people do not co-operate if one of them does all the work and the other has all the advantage. Two people cannot co-operate if one of them is master and the other is servant. I do not mean that a railroad man should not obey the orders of his official superior, but I mean that the relation between the two should be like the relation between a public executive and a citizen rather than like that between an emperor and a subject. It is necessary to have executives. But it is necessary also to protect the rights of the citizen. That is the reason we have codes of law, and speak of a government of law rather than a government of men. Our national government is a great co-operative enterprise.

Co-operation is, therefore, something stronger than a mere vague desire of a formless mass of people to help each other. It requires organization, an organization intelligent enough to make laws, and strong enough to enforce them. It requires organization which will define the relationships between executives and men in such a way that both may retain their equality while performing their respective duties, that the rights and privileges of both may be respected, and, consequently, that both may be free to co-operate with each other and render the maximum of service to the general public.

Where the Union Comes In

Here is where the union comes in. It furnishes an essential part of the co-operative organization. Bear in mind that absolute monarchies may have laws as well as republics. The difference is that in one case all the law comes from above, and in the other the people have a say. A railroad with no unions would be like an absolute monarchy. It

would have organization, but this would not be an organization in which true co-operation is possible. But a railroad which makes agreements with unions may be compared to a republic. The voluntary organizations of the men through those selected for that purpose represent their wishes and needs. The railroads through management represent their wishes and needs. The agreement between these two on wages, hours, working rules, and so on, is the code of law which protects the rights of both. It is the basis of organized co-operation.

It may seem strange to some that a union should be spoken of as an organization furthering co-operation between management and men. Has there not been much friction between them? Have there not been strikes? Of course there have been friction and strikes, but I firmly believe that these are a transitory phase of the relationship. It is only natural that in the beginning the representatives of both should feel their own desires vividly and the desires of the other side faintly. In the beginning, all railroads have operated like absolute monarchies. No absolute monarchy in history was changed into a truly constitutional government without a good deal of conflict between the crown and the people. Power is not given up easily or acquired easily. But in the end, all rulers and executives must come to see that they need help of the true representatives of the governed in the task of government. The union representatives on a railroad, if welcomed and given a fair opportunity to present the desires of their constituents, can help the management to remove causes of dissatisfaction which destroy morale. They may frame a code of industrial law under which the men can work with a feeling that they have had a part in its making and that justice is being accorded them. The men will be free and co-operating citizens of the road, subject to its laws and executives because they recognize their fairness and necessity. With such a feeling a man will work better than with the feeling that he is being driven against his will.

Unions as Co-operators

As long as unions are aggressively fought, they will aggressively fight back. When, finally, it is realized that they have come to stay, they may be tolerated as a necessary evil. The emphasis is still on friction and hostility. But when unions become recognized as a necessary part of the railroad's organism, they are then in a position to exercise their full powers in behalf of co-operation. They can turn to positive purposes. On the basis of justice and confidence, both sides can emphasize the mutual advantage in constructive measures. Because the organizations of labor have, in their former struggles, developed the power to refuse co-operation, they now have the power to exercise co-operation. This phase of the unions' activity is just beginning to come into being. It is a great power for good, and it may help to solve some of the biggest problems of the railroad industry.

I want to emphasize as strongly as I know how the fact that in the task of positive co-operation in the railroad industry there can be no substitute for the genuine unions of the railroad employees. When historians wish to test the character of any government they ask who controls the purse-strings. Who construes the right of suffrage? If the people, then the government is democratic. But if some king or autocratic agency levies the taxes, makes the appropriations and says who shall and shall not vote, then any outward form of democracy is but a sham and a delusion.

I wish to submit for your respectful consideration the nature and structure of our genuine railroad unions in their relation to railroad management as an aid in co-operation. These unions, 16 of them, the transportation brotherhoods, the shop crafts, the signalmen, the telegraphers, the clerks, the maintenance-of-way workers, are purely voluntary and democratic organizations of railroad employees. Taken in the aggregate they encompass in their membership and speak for at least 75 per cent or 1,500,000 of our 2,000,000 railroad

workers. They are entrusted by each individual member with authority to safeguard his economic welfare in the industry. This is their primary function. That they have grown and won the confidence of the vast majority of our railroad men testifies not only to their economic necessity from the viewpoint of the rank-and-file but also to their constructive possibilities from the viewpoint of the welfare of the transportation industry.

These organizations have developed leadership, have brought men to the front in whom the membership has implicit confidence, who talk for them, who guide them, who aid them, who are factors in American railroading. In short, you will find that there has grown up in the railroad industry, under the most democratic auspices yet designed by men, not only a group of leaders and representatives of our railroad workers who are trusted by their constituents, but also a remarkable tradition of fraternity, coherence and unity. There is spirit and purpose in these organizations, and they have developed that internal discipline necessary to sustain this spirit and carry forward this purpose.

The spirit and purpose to which I refer derives its greatest support from the interrelation of these organizations, their affiliation with one another, their mutual co-operation. This is what strengthens them, this is what gives the individual member self-reliance and pride in his position as a railroad man. This, perhaps more than anything else, is what safeguards his status, insures his stability and assures him the squarest deal possible in the matter of adjusting wages, working rules and grievances.

Now it is precisely the insurance of this spirit of organized labor, as made possible through affiliation of the workers on one railroad with those of other railroads and industries, which is so bitterly resented by those who profess to hope for lasting co-operation by building on foundations other than those of the genuine voluntary organizations of our railroad workers. But it is exactly the very presence of this spirit and the faculty for carrying through their purposes which places the regular unions in such an unusual position to develop co-operation with management to the highest degree possible. In other words, I maintain that no other type of employees' organization is as well constituted as the railroad unions of organized labor to benefit the railroad industry under a policy of true co-operation.

As I have already indicated, co-operation, when it is sound and enduring, must be absolutely voluntary. No duress, no matter how remotely or indirectly applied, no artificial stimulation, through special financial incentives such as piece work, no intriguing the conventional forms of "non-financial" incentives, profit sharing, or employee stock sales will create lasting voluntary co-operation on the part of the railroad workers. Nor indeed does any artificially created, unaffiliated, undemocratic organization of employees provide the foundation upon which to build real co-operation. In the very nature of things the latter type of organization can and does exist only by managerial fiat. It dare not tolerate in its ranks employees who are loyal to legitimate organized railroad labor. Witness the turmoil on those roads where for instance the shop strike has been disposed of and where so-called company unions are trying to function and where men are obliged to drop their union membership if they wish to enter or remain in the service.

The B. & O. Experiment

Some time ago I said publicly that the International Association of Machinists was searching eagerly for a progressive employer who would, on the basis of full recognition of the union, accept our co-operation for the increasing of efficiency and the furthering of economy in the interest of service to the public. It would be understood, of course, that any benefits accruing to the concern through improved service would be shared justly between the parties responsible therefor. Since that time we, together with the other

railroad shop crafts, have found such an employer in one of the great railroad systems of the country—the Baltimore & Ohio. We have made an agreement for mutual co-operation, and have worked out a concrete experiment in the shops, with which both sides are pleased. I think we can now give points in efficiency and economy, in better shop service, in improved morale, to any railroad which relies on piece work or other speeding-up devices, or seeks to circumvent genuine trade unionism.

Briefly I might summarize the development in co-operation on the Baltimore & Ohio, first, as the acceptance by the Baltimore & Ohio management of the standard shop craft unions as the proper agencies representing the shopmen. But instead of being simply tolerated as a necessary evil, with a purely negative attitude toward the welfare of the railroad, they are now regarded as desirable agencies in the stimulation of human efficiency on the Baltimore & Ohio. Thus the ordinary negative attitude which results from the usual status accorded the shop unions by most managements is here displaced by a constructive, helpful attitude toward management.

On the basis of this understanding we have, among other things, placed at the disposal of the Baltimore & Ohio a service to help improve the morale of the mechanical department through our union organizations. It is our purpose to align the locals, shop federation, districts and system federations of the Baltimore & Ohio shopmen definitely behind a constructive program of improved shop, yard and roundhouse operation, better maintenance service, increased production, safety and the elimination of waste. The management on the other hand has assured us that it will do what it can to make this improved maintenance economy count in the direction of steady work the year around. Thus the men need have no fear that better production on their part is going to result in furloughs just that much sooner, as ordinarily happens on railroads where narrow economy, piece work and anti-union policies prevail. And finally it is definitely accepted by both management and shopmen that.

"The welfare of the Baltimore & Ohio Railroad and its employees is dependent on the service which the railroad renders the public. Improvements in this service and economy in operation and maintenance expenses result chiefly from willing co-operation between the railroad management and the voluntary organizations of its employees. When the groups responsible for better service and greater efficiency share fairly in the benefits which follow their joint efforts, improvements in the conduct of the railroads are greatly encouraged. The parties to this agreement recognize the foregoing principles and agree to be governed by them in their relations."

This quotation is the preamble to the agreement negotiated last May between the Baltimore & Ohio management and the Baltimore & Ohio System Federation No. 30. It reflects the spirit and purpose which guides the individual unions composing this federation in their relation to the Baltimore & Ohio Railroad.

The service we have put at the disposal of the Baltimore & Ohio is of the most superior engineering character. It is under the general direction of O. S. Beyer, Jr., who is retained by us as consulting engineer. Mr. Beyer, aside from his training as an engineer in our best technical schools, his practical experience as a railroad man which he acquired in the service of the industry, has a grasp of the human problems of railroading which is not only necessary but indispensable for the guidance of such a service.

The Underlying Idea

The idea underlying our service to the Baltimore & Ohio may be compared to the idea which underlies the engineering services extended to railroads by large supply corporations which have contracts with these railroads to furnish, let us say, arch brick, superheaters, stokers, or lubricating oils. The union members furnish their services, and also help the road with expert advice as to how to employ those services to the best advantage to all. In response to the recognition

accorded us by virtue of the agreement or contract existing between us and the management it becomes peculiarly feasible for us to take steps which will develop greater confidence between management and men, and create, as it were, an all-pervading collective will for the major purposes of railroading; namely, efficient satisfactory service to the public, a fair return to the investors and adequate wages and steady employment for the workers.

The developments on the Baltimore & Ohio, to which I refer, have now been under way definitely since last February. There is not time here to go into the details of these developments. Suffice to say that one of the principal shops of that railroad was selected in which to work out the technique of co-operation under Mr. Beyer's direction. This has now been done and the results achieved are being worked up in report form as a practical object lesson of the benefits to be derived from co-operation. At the same time the general labor policy upon which co-operation on the Baltimore & Ohio is based is being brought home to every representative of management and every union representative as well as to every shopman all over the system. So that when this new policy is thoroughly understood it simply becomes a matter of taking definite practical steps to carry it over into the multitudinous daily actions and relations which constitute railroad maintenance operation.

Conclusion

In conclusion, let me emphasize just two important things. First, although we have been intensively active on the Baltimore & Ohio for barely eight months, and the surface, so to speak, has hardly been scratched, the effect of the new policy of co-operation on that road is clearly manifesting itself in the splendid service the road is rendering the public, the high economy with which it is being operated and the excellent morale which prevails through the rank-and-file. These facts are statistically demonstrable, especially when we compare the Baltimore & Ohio with some of its competitors who maintain a different labor policy. Second, I want to say that we, the legitimate, standard, genuine unions of the shopmen, are more than eager to offer the same positive co-operation to any railroad management which is intelligent enough and courageous enough to see the inevitable logic of events and one whose railroad conditions are ripe for such co-operation. I maintain that such a management would never again, as long as it retains its good senses, desire to see the affiliated shop crafts effaced from the scheme of things on its road.

A Suggested Basis of Proportions for Driving Axle Keys

By H. J. Coventry

Mechanical Engineer, Harry Vissering & Co., Chicago

DRIVING axle keys, being a small item and in the nature of a security device rather than a means of sole fixing of wheel to axle, have not, perhaps, received much attention, hence it has been considered sufficient to make the key dimensions of width and thickness bear some relation to the axle diameter and to base standard sizes accordingly. That this method is not entirely correct will be appreciated when it is remembered that a driving axle must be designed for combined torsion and bending. Obviously, the key is entirely independent of the bending of the axle and takes only the torsional shear force. Hence a particular key might be quite suitable for entirely different diameters of axles.

For practical reasons and in order to limit the number of sections of key steel stock it is inevitable that some keys would be more heavily stressed than others but, if a suitable basic stress is adopted, any divergence above or below will not be detrimental.

In the diagram, Fig. 1, let

T = force at periphery of wheel in pounds
F = force acting on key in pounds
d = diameter of axle in inches
D = diameter of wheel in inches
b = breadth of key in inches.
t = thickness of key in inches
l = length of key in inches

Length of key is usually made $\frac{1}{4}$ in. less than wheel seat.

Take shear stress at 10,000 lb. sq. in. and bearing pressure at 25,000 lb. sq. in. for high grade steel.

$$\text{Area to shear} = \frac{b \times l}{2}$$

$$\text{Area to bearing} = \frac{t \times l}{2} \text{ assuming key is sunk for half its thickness in the axle.}$$

$$\text{Then } F = \frac{10,000 b l}{25,000 t l} \quad (1)$$

$$\text{and } F = \frac{10,000 b}{2} \quad (2)$$

$$\text{from which we find } t = \frac{10,000}{12,500} b = .8b \quad (3)$$

As the key or keys in one wheel will only be required to transmit half the total work of the cylinders, we may take T

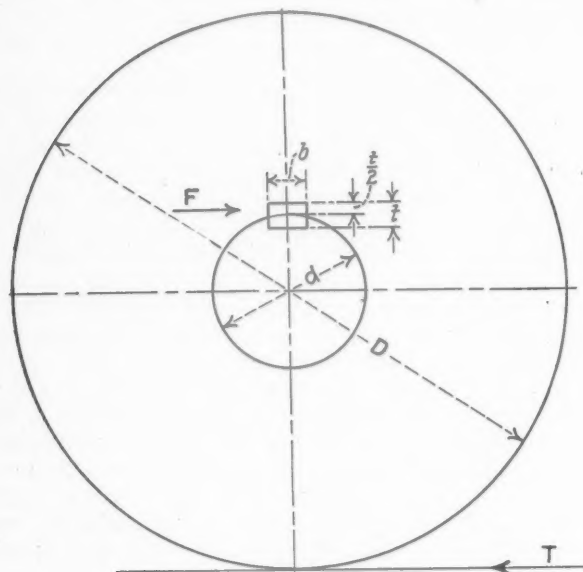


Fig. 1

equal to half the tractive effort. (For Mallet engines, take half the tractive effort developed by one set of cylinders.)

$$\text{From the principle of moment } F \times \frac{d}{2} = \frac{T}{2} \times \frac{D}{2}$$

$$F = \frac{T D}{2d} \quad (4)$$

where Te = tractive effort in pounds. Substituting the value of F in equation (1)

$$\frac{T D}{2d} = 10,000 b l$$

$$\text{and } b = \frac{T D}{20,000 d l} \quad (5)$$

We now have the breadth of key as a function of four variables, and while this formula gives correct values its use would entail a different key for almost every case. A process of averaging has therefore been adopted, reducing the value of b to a function of Te and D.

From a large number of existing engines representing over

60 different sets of values for tractive effort, axle diameter, wheel diameter and seat, a table has been made, a sample of which is given in Table I.

Key width b was calculated in each case by equation (5). The values of the product of Te and D and b were then plotted as shown on Fig. 2.

It will be noticed that while the plotted points are consid-

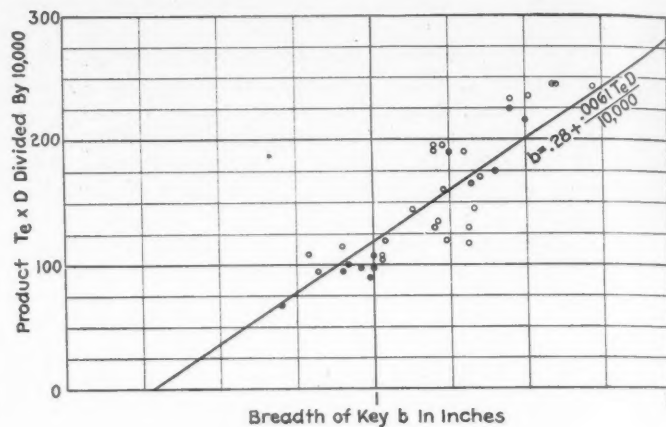


Fig. 2

erably scattered, they do tend in a general direction, and this is estimated by the straight line drawn among the points.

The law to a straight line graph is

$$b = a + c T e D$$

where a and c are constants.

Taking any two simultaneous values for b and Te D from the line, we may find the value of b or the equation of the line. This comes to

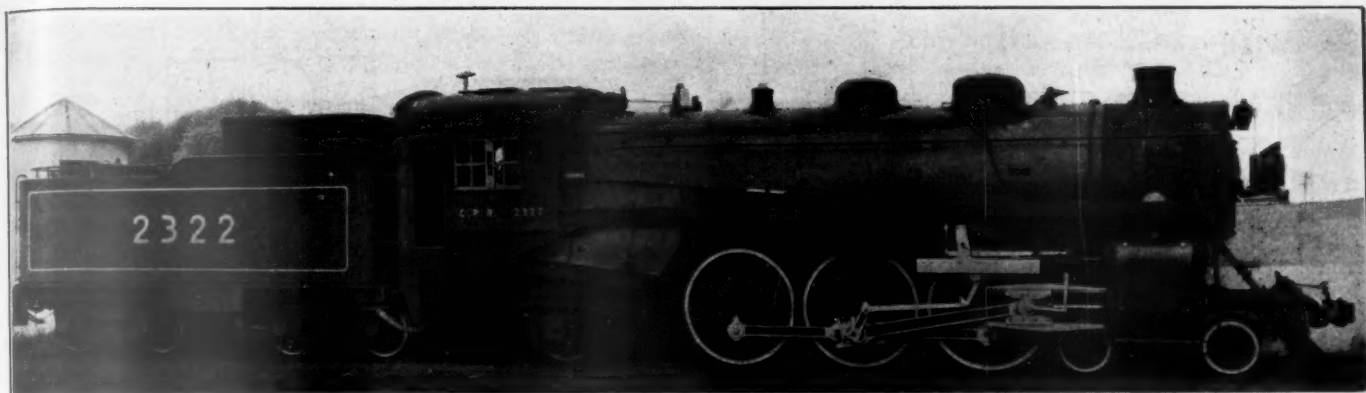
$$b = .28 + .0061 \frac{T e D}{10,000}$$

From this equation, the values of b have been calculated and the nearest practical size taken. A sample is shown in Table II and the complete list made from this working is given as Table III.

Engine	Te	d x l	D	Te x D	b
A	27,200	8 3/4 in. by 7 1/2 in.	63	1,710,000	1.35
B	41,946	9 3/4 in. by 7 1/2 in.	51	2,140,000	1.5

Wheel diameter	Tractive force	Calculated key width	Key size	Number of keys
51 in.	20,000 lb.	0.9 in.	1 in. by 3/4 in.	1
63 in.	40,000 lb.	1.82 in.	7/8 in. by 3/4 in.	2
63 in.	75,000 lb.	3.16 in.	1 1/2 in. by 1 1/4 in.	2
75 in.	35,000 lb.	1.85 in.	7/8 in. by 3/4 in.	2

Wheel diameter	Tractive force	Key size	Number of keys
51 in.	20,000 lb.	1 in. by 3/4 in.	1
51 in.	40,000 lb.	7/8 in. by 3/4 in.	2
56 in.	15,000 lb.	7/8 in. by 3/4 in.	1
56 in.	20,000 lb.	7/8 in. by 3/4 in.	1
56 in.	25,000 lb.	1 1/8 in. by 7/8 in.	1
56 in.	30,000 lb.	1 3/8 in. by 1 in.	1
63 in.	15,000 lb.	7/8 in. by 3/4 in.	1
63 in.	20,000 lb.	1 in. by 3/4 in.	1
63 in.	25,000 lb.	1 1/4 in. by 1 in.	1
63 in.	30,000 lb.	1 1/2 in. by 1 1/4 in.	1
63 in.	35,000 lb.	7/8 in. by 3/4 in.	2
63 in.	40,000 lb.	7/8 in. by 3/4 in.	2
63 in.	45,000 lb.	1 in. by 3/4 in.	2
63 in.	50,000 lb.	1 1/8 in. by 7/8 in.	2
63 in.	55,000 lb.	1 1/4 in. by 1 in.	2
63 in.	60,000 lb.	1 1/2 in. by 1 in.	2
63 in.	65,000 lb.	1 3/4 in. by 1 1/4 in.	2
63 in.	70,000 lb.	1 3/4 in. by 1 1/4 in.	2
63 in.	75,000 lb.	1 3/4 in. by 1 1/4 in.	2
75 in.	15,000 lb.	1 in. by 3/4 in.	1
75 in.	30,000 lb.	1 1/2 in. by 1 1/4 in.	1
75 in.	35,000 lb.	7/8 in. by 3/4 in.	2
75 in.	40,000 lb.	1 in. by 3/4 in.	2
75 in.	50,000 lb.	1 1/4 in. by 1 in.	2
79 in.	20,000 lb.	1 1/4 in. by 1 in.	1
79 in.	25,000 lb.	1 1/2 in. by 1 1/4 in.	1
79 in.	30,000 lb.	7/8 in. by 3/4 in.	2



Class G-3c Pacific Type Locomotive for the Canadian Pacific

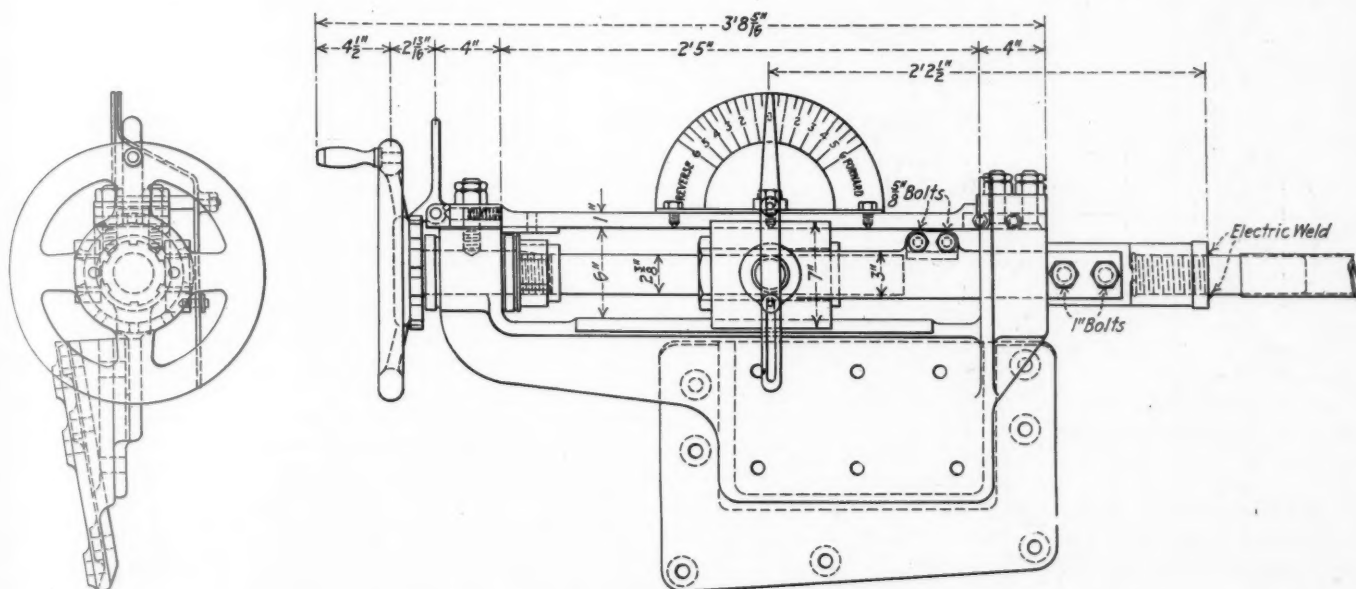
Canadian Pacific Standard 4-6-2 Locomotive

Heavy Pacific Type with Well-Proportioned Boiler—Interesting Trucks and Many Improvements in Details

IMPORTANT passenger trains on the Canadian Pacific have been handled for many years by locomotives of the Pacific type with driving wheels of 75 in. and 70 in. diameter. For quite a period locomotives having a tractive force of from 30,000 lb. to 35,000 lb. were sufficiently powerful to meet traffic conditions, but an increasing number of passenger cars to a train, greater weights of the cars and a desire to furnish first-class service made it necessary to increase materially the power of the locomotives. After a thorough study of the situation, two new designs of Pacific type locomotives were brought out in 1919 to meet the requirements of operation even in severe winter weather and to

Angus shops, Montreal, 10 locomotives of Class G3, numbered in the 2,300 series, and 18 locomotives of Class G4, numbered in the 2,700 series. Both classes were given long tests under all kinds of conditions and on many divisions. As a result of these extended tests, which included careful observations of the actions of all parts of the machinery and boilers, a somewhat modified design, known as Class G3c, has been completed and adopted as the standard Pacific type for heavy main line passenger trains. Sixteen locomotives of the new design have been built this year by the Montreal Locomotive Works and are now in service.

These new passenger locomotives which are numbered



A Screw Reverse Gear Gives Close Adjustment of Cut-off

conform to the limitations of bridges and right-of-way restrictions. The two designs were similar. One, known as Class G3, had 25-in. by 30-in. cylinders, 75-in. driving wheels and a tractive force of 42,600 lb. The other, known as Class G4, had 24 1/2-in. by 30-in. cylinders, 70-in. driving wheels and a tractive force of 43,700 lb. In the period of 1919, 1920 and 1921, the Canadian Pacific built at the

2310 to 2325 inclusive, have 25-in. by 30-in. cylinders, 75-in. driving wheels, 2,252 cylinder horsepower, and a rated tractive force of 42,600 lb. The weight in working order of the engine alone is 300,500 lb., of which weight 181,500 lb. is on the drivers, 60,000 lb. on the front truck and 59,000 lb. on the trailing truck. These weights give a factor of adhesion of 4.26 and a locomotive weighing 133.7

lb. per cylinder horsepower. The tender is of the rectangular water bottom type, weighs 188,500 lb. in working order and carries 8,000 Imperial gallons (9,600 U. S. gallons) of water and 12 tons of coal.

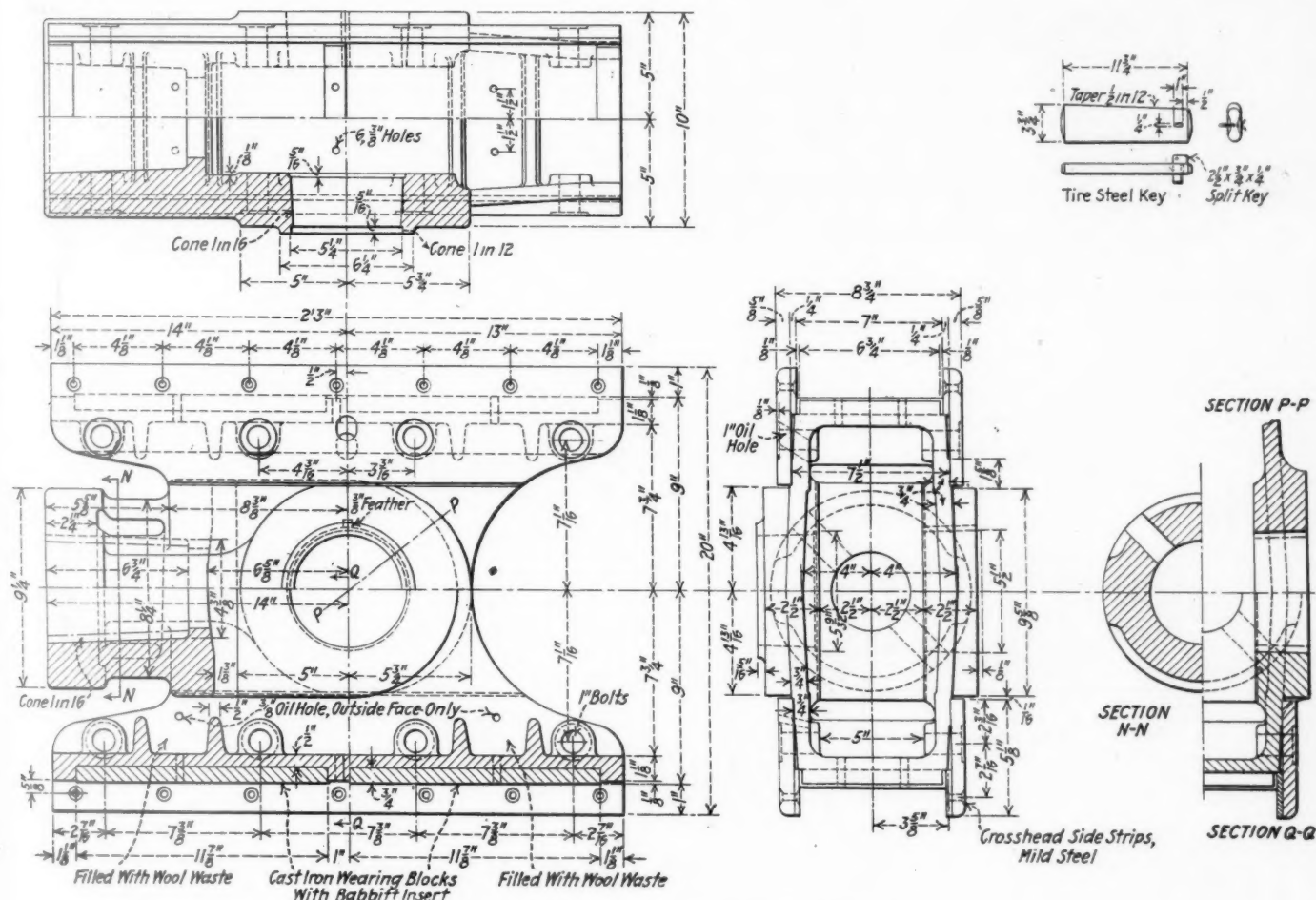
Ample Boiler Capacity Provided

Adequate boiler capacity is of prime importance if a locomotive is to handle satisfactorily passenger traffic on the Canadian Pacific where trains of 12 or more heavy passenger cars are not unusual. In many places the movements of other trains and, in fact, the successful operation

and 18 ft. 6 in. long. The evaporative heating surface is 3,530 sq. ft., which includes 298 sq. ft. in the firebox, combustion chamber and arch tubes and 3,232 sq. ft. in the tubes and flues. The type A superheater has a heating area of 830 sq. ft.

The barrel of the boiler has three courses, the first one having an inside diameter of 78¼ in. The dome, which is 33 in. inside diameter, is located on the second course. This simplifies the seam construction and shortens the dry pipe.

The firebox is 111½ in. long by 84¾ in. wide inside,



The Crosshead Is Fitted with Detachable Side Strips

of a division, depends upon passenger trains being kept on schedule. While reserve boiler capacity is always an advantage, it becomes of prime importance when the thermometer is below zero, the coal is frozen and mixed with snow and an increasing demand for power to meet greater frictional and train resistances comes at a time when a large amount of steam is required to heat the train and to run the air compressor at an increased speed to supply air for the extra brake pipe leakage. An appreciation of these conditions led to the adoption of a boiler which has a capacity of 101.8 per cent when calculated by Cole's ratio. All boiler details have been carefully proportioned—grate area, firebox volume, heating surfaces, gas area and air admission areas. The engines are consequently free steamers and have demonstrated their ability to furnish ample steam to meet all requirements.

In accordance with previous Canadian Pacific designs, the boiler is of the straight-top, extended-wagon-bottom type with a combustion chamber 26 in. long and radial stays. The steam pressure carried is 200 lb. per sq. in. There are 205 tubes, 2¼ in. diameter, and 38 flues, 5½ in. diameter,

which gives a grate area of 65 sq. ft. The firebox door opening is flanged with a large radius and projects through the flanged opening in the back head, the two sheets being riveted together in accordance with successful Canadian Pacific practice. The Security brick arch is carried on five 3-in. tubes placed well above the mud ring at the front end. The grates are of the butt-finger type, no special dump grate being provided. The brackets, which support the grate bars, also carry the ash pan. Firing is done by hand. The fire door is of the air-operated butterfly type, Franklin No. 8. The boilers are fed by two Hancock No. 10, type A inspirators.

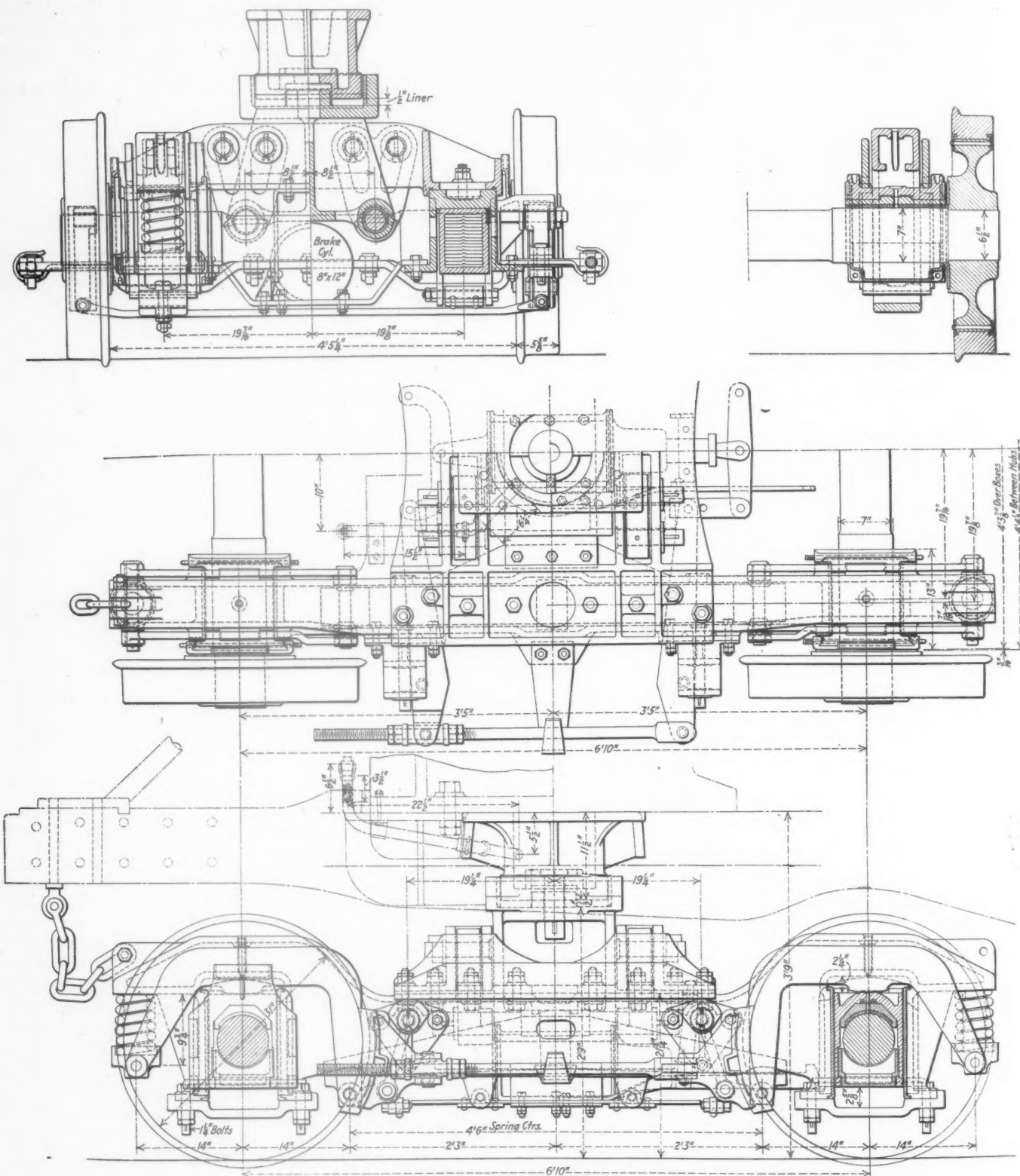
Engine and Running Gear

The cylinders are of an unusually substantial design, double bolted together and provided with a flange at the back through which pass bolts which hold the cylinders to special lugs on the front frame extension. The 14-in. piston valve is operated by a Walschaert gear.

The frames are of the single front rail type, of vanadium cast steel, specially heat treated. At the back they are at-

tached to a Commonwealth cast steel cradle casting. These are the first locomotives on which a one-piece cradle casting has been used in conjunction with a Vaughan trailing truck. This type of trailing truck has been the standard on the Canadian Pacific for many years, and when used with

The three drivers on a side and the trailing wheel are equalized together, a long equalizer being used to connect the spring hanger back of the third driver with the forward spring hanger of the trailing truck wheel. The spring hanger back of the trailing truck wheel is held in tension



Front Truck for Canadian Pacific 4-6-2 Locomotive

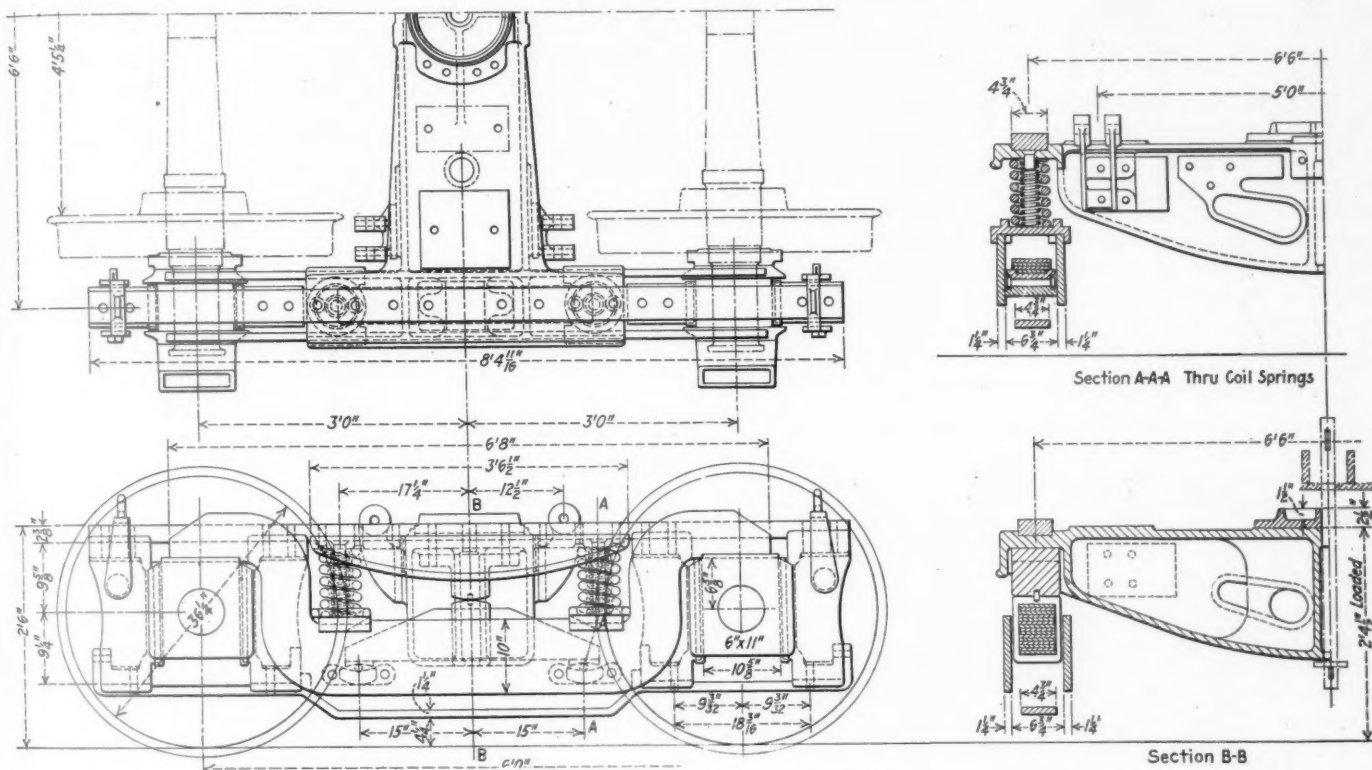
a Commonwealth cast steel cradle affords an unusually large space for the ash pan and furnishes excellent accessibility. The large ash pan is fitted with doors which swing closed by gravity.

by a strong coiled spring underneath the truck frame. This method of equalization is considered to be largely responsible for the excellent riding qualities of these engines.

Another factor in the riding qualities is the design of the

front truck, which is shown in one of the drawings. The two cast steel side frames of channel-shaped section are bolted to a substantial center casting. The journal box pedestals are integral with the side frame, which also contains a spring seat and a pocket for the semi-elliptic spring. The design has been changed somewhat from that used

formerly and permits of an easier application of the springs. Equalizers resting on the journal box connect the ends of the semi-elliptic spring to spring seats at the outside corners where coil springs transmit the thrusts to the side frame. The wheels are steel tired, 31 in. diameter, and have cast steel centers. The journals are 7 in. by 13 in. The journal



Four-Wheel Tender Truck for Class G-3c Pacific Locomotive

TABLE OF DIMENSIONS, WEIGHTS AND PROPORTIONS

Railroad	Canadian Pacific
Builder	Montreal Loco. Wks.
Type of locomotive	4-6-2
Service	Passenger
Cylinder, diameter and stroke	25 in. by 30 in.
Valve gear, type	Walschaert
Valves, piston type, size	14 in.
Maximum travel	7 in.
Outside lap	1 1/4 in.
Exhaust clearance	1/4 in.
Lead in full gear	1/4 in.
Cut-off in full gear, per cent.	85

Weights in working order:

On drivers	181,500 lb.
On front truck	60,000 lb.
On trailing truck	59,000 lb.
Total engine	300,500 lb.
Tender	188,500 lb.

Wheel bases:

Driving	13 ft. 2 in.
Rigid	13 ft. 2 in.
Total engine	34 ft. 9 in.
Total engine and tender	67 ft. 1 in.

Wheels, diameter outside tires:

Driving	75 in.
Front truck	31 in.
Trailing truck	45 in.

Journals, diameter and length:

Driving, main	11 1/2 in. by 21 in.
Driving, others	10 1/2 in. by 14 in.
Front truck	7 in. by 13 in.
Trailing truck	9 in. by 14 in.

Boiler:

Type	St. top—extended wagon bottom
Steam pressure	200 lb.
Fuel, kind	Bituminous
Diameter, first ring, inside	78 1/4 in.
Firebox, length and width	111 1/4 in. by 84 3/4 in.
Height mud ring to crown sheet, back	5 ft. 6 1/4 in.
Height mud ring to crown sheet, front	7 ft. 2 1/4 in.
Arch tubes, number and diameter	3—3 in.
Combustion chamber length	26 in.
Tubes, number and diameter	205—2 1/4 in.
Flues, number and diameter	38—5 1/2 in.
Length over tube sheets	18 ft. 6 in.

Gas area through tubes	4.6 sq. ft.
Net gas area through flues	3.26 sq. ft.
Total gas area through tubes and flues	7.86 sq. ft.
Air inlet through grates	20.54 sq. ft.
Air inlet to ash pan	9.4 sq. ft.
Grate type	Butt finger, no dump
Grate area	65 sq. ft.

Heating surfaces:

Firebox and comb. chamber	258 sq. ft.
Arch tubes	40 sq. ft.
Tubes	2,224 sq. ft.
Flues	1,008 sq. ft.
Total evaporative	3,530 sq. ft.
Superheating	830 sq. ft.
Comb. evaporative and superheating	4,360 sq. ft.

Tender:

Style	Rect. water bottom
Water capacity	8,000 imp. gal.—9,600 U. S. gal.
Fuel capacity	12 tons

General data estimated:

Rated tractive force, 85 per cent.	42,600 lb.
Cylinder horsepower (Cole)	2,252 hp.
Boiler horsepower (Cole) (est.)	2,293 hp.
Speed at 1,000 ft. piston speed	44.6 m.p.h.
Steam required per hour	46,840 lb.
Boiler evaporative capacity per hour	47,640 lb.
Coal required per hour, total	7,320 lb.
Coal rate per sq. ft. grate per hour	112.5 lb.

Weight proportions:

Weight on drivers ÷ total weight engine, per cent.	60.5
Weight on drivers ÷ tractive force	4.26
Total weight engine ÷ cylinder hp.	133.75
Total weight engine ÷ boiler hp.	131.2
Total weight engine ÷ comb. heat. surface	69

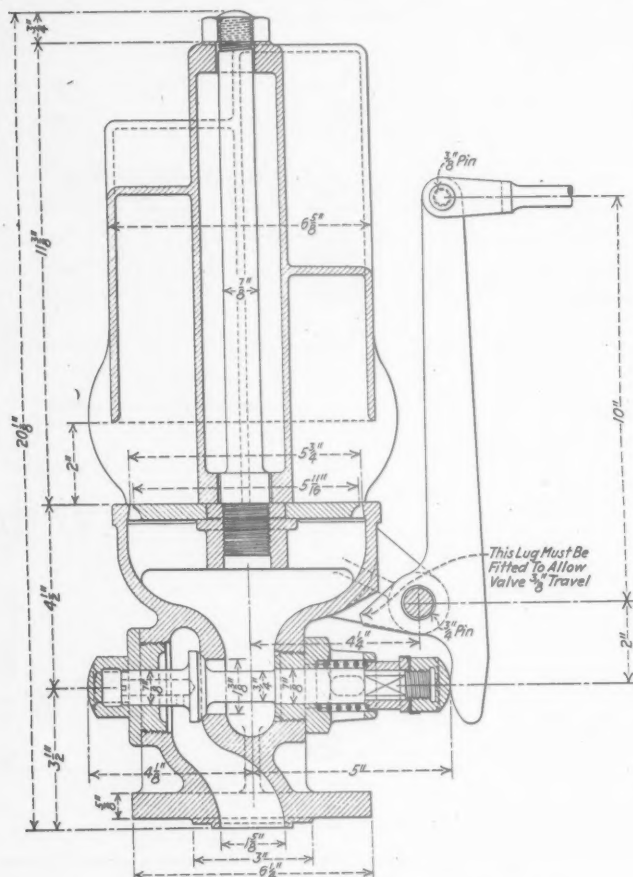
Boiler proportions:

Boiler hp. ÷ cylinder hp., per cent.	101.8
Comb. heat. surface ÷ cylinder hp.	1.94
Tractive force ÷ comb. heat. surface	9.78
Tractive force × dia. drivers ÷ comb. heat. surface	734
Cylinder hp. ÷ grate area	34.61
Firebox heat. surface ÷ grate area	4.58
Cylinder hp. ÷ gas area (tubes and flues)	286
Grate air inlet ÷ grate area, per cent.	31.6
Ash pan air inlet ÷ grate area, per cent.	14.45
Firebox heat. surface, per cent of evap. heat. surface	8.4
Superheat surface, per cent of evap. heat. surface	23.5
Tube length ÷ inside diameter	110.5

boxes are fitted with double-faced cast brass liners and hub liners are also applied to the wheels.

Other Interesting Features

The crosshead has been improved by the application of side liners on each side as shown in one of the drawings.



Improved Chime Whistle with Horizontal Valve

These detachable side liners facilitate the renewal of the side wearing strips.

The reverse gear is of the screw type commonly employed on this road. The screw is $2\frac{3}{8}$ in. diameter and has a double left-hand thread of $1\frac{1}{2}$ in. pitch, which permits of a finely graduated adjustment of the cut-off.

A new type of whistle has been applied to these locomotives. It is of the four-chamber chime type, and is provided with a flange by which it is bolted on. The valve is horizontal and can be removed without disturbing the bell.

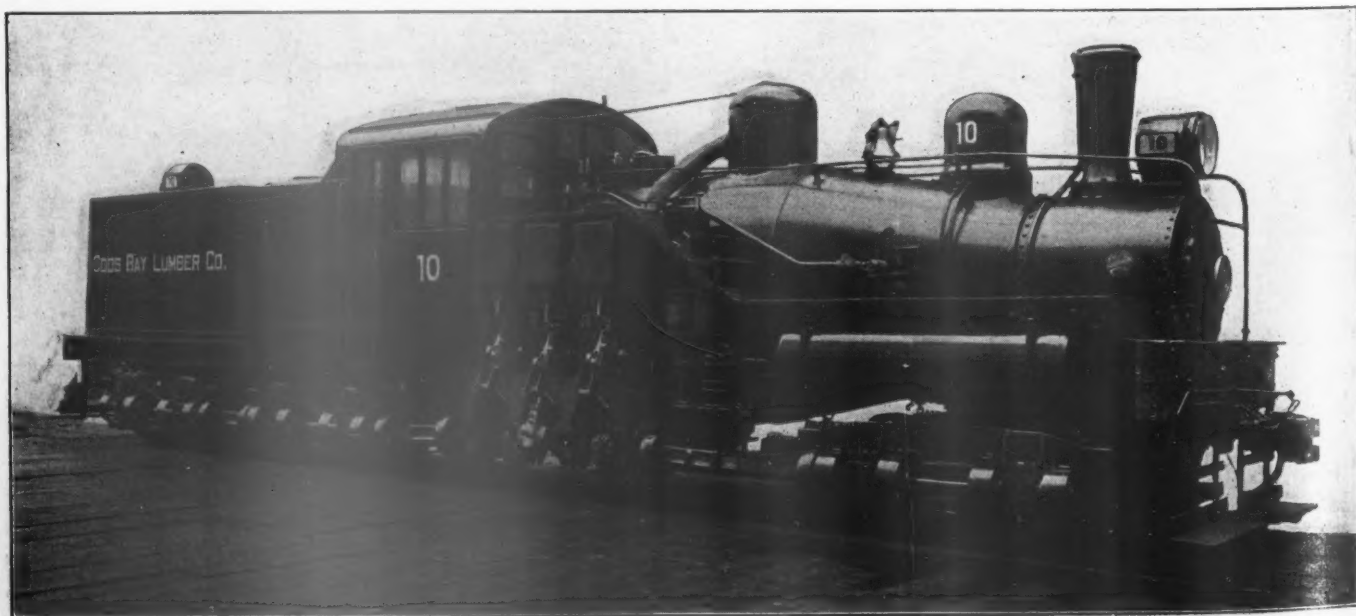
The cab is of the railroad standard enclosed vestibule type, while the location of fittings and piping has been given careful attention. Large lockers have been provided for the convenience of the engineman and fireman. The cylinders and the air compressor are lubricated by a Detroit force feed lubricator. Other specialties, not mentioned, include Pyle electric headlight, Westinghouse $8\frac{1}{2}$ -in. cross-compound air compressor, Barco joints in air and steam piping between engine and tender, King piston rod and valve stem packing and Franklin grease lubrication of driving box journals.

Tender

The tender has been redesigned with a one-piece bottom. The swash plates are of corrugated form instead of plain sheets with stiffening angles as ordinarily applied. Another improvement has been to remove the tank well operating valve rod from the coal space; the valve is now operated from the front of the tank well. The design of the coal space is such that the coal slides forward to the shovel plate and thus reduces the labor of the fireman. The frame is a Commonwealth cast steel design.

The trucks are of the four-wheel equalizer type. The wheels have steel tires, $36\frac{1}{4}$ in. diameter, and cast steel centers and the journals are 6 in. by 11 in. The truck bolster and the pedestals are of cast steel. An opening through the bolster permits the brake rod to pass through instead of underneath as on previous trucks. An excellent cushioning is obtained by the employment of a longitudinal, semi-elliptic spring and two coil springs on each side.

The accompanying table gives the principal dimensions and proportions of these locomotives, which are interesting for their careful design, careful attention to proportions and attractive appearance.



Geared Locomotive Built by the Willamette Iron & Steel Works, Portland, Oregon

The Fundamentals of Fuel Economy

Paper Showings Wasteful—Systematic Education and Careful
Selection of Employees Essential

By W. L. Richards

Locomotive Engineman, Union Pacific, North Platte, Nebr.

[Abstract of a paper which won the prizes in the International Railway Fuel Association contest for the best paper on fuel economy submitted by an engineman, fireman, conductor, brakeman, or switchman. It deals with the fundamentals of the subject in a constructive and suggestive manner.—Editor.]

THAT the performance of any work whatsoever requires an expenditure of energy is an accepted fact; it is also a commonly accepted axiom that heat is the source of all energy, that is, that no work can be accomplished or power furnished without first providing heat. All sources of power and energy may be finally traced to heat.

Railroads are engaged in the business of transportation, i.e., the carrying of articles of commerce and persons from one place to another. To do this requires the provision of the necessary energy; hence the primary business of railroading is the business of furnishing energy to move things of weight.

To furnish this energy requires heat, and fuel is the principal source of this heat.

There are two ways in which the consumption of fuel may be lessened. The first is by lowering the amount of energy necessary to do a given piece of work; the second, by getting a greater amount of energy from the fuel consumed. As both are controlled by those who are in charge, it would seem to be logical to say that three elements enter into the economical use of fuel, namely, operation, mechanical and personnel. It is from these three viewpoints that the subject will be considered.

Operation

In the operation of a railroad from a fuel economy standpoint, we are mainly concerned in the first way of saving, that is, in reducing the amount of work necessary to perform the service required. Under this head comes the reducing of road grades, the elimination of unnecessary car and engine mileage, the making up of trains so as to reduce the tractive effort to haul them, the rating and providing of locomotives with trains which show the least fuel consumption per ton per mile hauled, the doing away with unnecessary terminal and road switching, the careful making up of time-table schedules so that the runs over the district concerned can be made with uniform speed and effort; the prompt handling of freight and passenger traffic so as to minimize delays and the avoidance of every train stop possible.

Perhaps much has been accomplished along the lines mentioned in the preceding paragraph, but there undoubtedly remains a great deal yet to be done before we can say that we have reached satisfactory results. Take the matter of yard or terminal switching; I have in mind a case on a well managed railroad wherein a chief dispatcher had two trains made up at a certain terminal and they were run as made up to the end of that chief dispatcher's jurisdiction, but, at the terminal where another chief dispatcher took charge of the movement, these two trains were ordered remade up in a manner that required 65 switches handling

from 9 to 45 cars at each switch. It took two hours and twenty minutes of a full yard crew's time and burned at least two and one-half tons of coal. This is, perhaps, an exceptional case, but there are many, many cases of less magnitude happening on our best railroads every day, nearly all of which could be avoided if the trains were made up in the first instance under instructions that took into consideration the movement of all cars clear through to destination or to the end of that line—instructions which succeeding yard masters and chief dispatchers were bound to respect.

The Evils of "Paper Showings"

There is also another phase of operation which is reflected in the fuel consumption of a railroad and that is what is commonly known as making a "paper showing." It is practised in nearly all departments and seems to be demanded by the system of accounting now in vogue.

This "paper showing" often appears in keeping up the tonnage showing of a district, wherein one locomotive is sent out heavily loaded, followed, perhaps, by one running light because the power is needed at the other end of the district and the "light" is not charged against the tonnage per train of the district. Tests show that to have run two small trains instead of the heavy train and the "light" would have resulted in the saving of considerable fuel and in either case the other expense for crews, etc., would have been the same.

The amount of coal issued to locomotives is sometimes overcharged to make up for the shortage in the weight of coal between the mines and point of consumption, in order to keep from showing up this loss. But the practice does not gain us one pound of additional fuel. It would be much better to make a true and exact charge, letting the shortage show and taking steps to correct it if large. By so doing, we save ourselves a loss and also know that the records of actual fuel consumed were accurate.

Boards of directors and stockholders may have to be asked to look a little further into the future and give a little more leeway to the management in order to accomplish what appears to be necessary to the real saving of fuel. I refer to the practice of trying to show high net operating revenues at all seasons of the year. On most of our roads the business is seasonal and when the traffic is at the highest point mechanical forces are increased without stint in order to keep every available locomotive at work. But, at best, only the work absolutely necessary to keep the engine in service can be done, as it cannot be held idle long enough to be put in first class mechanical condition. As a result much fuel is wasted; in fact, the matter of fuel economy is generally lost sight of during these periods. Then just as soon as business slacks and gross revenues begin to fall, mechanical forces are reduced in an effort to keep up the percentage of net revenue, with the inevitable result that the roads enter into another rush with the power in as poor condition as before.

At its best, this is a poor policy and is only "robbing Peter to pay Paul." When business began to fall off, had the full mechanical forces been kept at work until every locomotive had been put in the pink of condition, the money spent then would have been more than saved in the next campaign because when engines are idle more work can be accomplished for the same expenditure. Furthermore, many thousands of

tons of fuel could be saved for the reason that each machine would enter the rush in an efficient fuel-saving condition and could be maintained in that condition.

The policy outlined would also result in a further saving, as mechanical forces would be kept at a more constant level throughout the year. The filling of the shops with undesirable help during stress periods could be avoided and the cost of labor turn-over thereby reduced. This, of course, is not strictly fuel economy but would be a direct result of it.

Mechanical Factors

Although fuel is used in every department of a railroad, by far the largest percentage is that consumed by its locomotives. A locomotive is a very wasteful machine at its best as far as fuel is concerned. During the government operation of the railroads, a bulletin issued by the Director General gave the amount of heat usefully applied to draw-bar pull by the average locomotive as only six per cent of the total amount of heat in the coal consumed. This means that for every 100 lb. of coal burned only 6 lb. is really saved to do the work required. From this fact it is easy to learn that we must devote our attention mainly to our engines if we are to save fuel in a mechanical way.

This bulletin gives the largest amount of heat loss as that passing out of the stack—52 per cent—and it is to overcoming this high percentage that the mechanical department should devote the major portion of its efforts. This means that every attention should be given to valves and cylinders; the cages of the former (the modern piston valve being under consideration) should be bored true and kept in that condition, as should also the cylinder walls, and both should be fitted carefully with rings of the proper size with just the right amount of spring in them to make their movement steam tight. If any of the live steam gets by it increases our percentage going out the stack, and this cannot be permitted if we are to save fuel. The setting of locomotive valves is a moot question and therefore careful experiments should be made by each road to determine the setting that is most economical for its requirements and when once the standard is determined, the valves should be run over as often as may be necessary to maintain it. Lame engines are to be avoided as fuel wasters.

The next great loss is that of unburned gases passing out the stack, this loss being given at 14 per cent. It is to this factor that attention should be given after the exhaust loss has been reduced to a minimum. For every ton of coal burned in a locomotive, from 10 to 14 tons of air are required to be drawn into the firebox to furnish the oxygen necessary for combustion. This air, remaining only a few seconds, must be heated to a high temperature, its various gases combined with other gases liberated from the burning coal and the greatest possible amount of the heat thereby generated transferred to the water to form steam. We must have the required amount of air to make the gases burn with the greatest amount of heat, but given that amount, more causes waste, for we have to heat more than is necessary and it is thrown out the stack again, a total loss. Things which cause more air to be drawn in than necessary and therefore to be avoided are steam and water leaks in the firebox; too straight a passage, causing failure of the air to properly mix with the gases of the coal; too limited a heating surface for the hot gases to come in contact with, and also allowing these metal surfaces to become coated with scale or soot. A leading authority says that a metal surface coated with 1/16 in. of scale or soot will transmit 14 per cent less heat than a clean surface of the same material. These figures will give us an idea of just how important it is that accumulations of this kind be avoided. Brick arches are a great aid in the mixing of gases in the firebox and should be maintained in good order and of proper size.

Keeping Power Tuned Up

Economical locomotive practices are so well known that it should be unnecessary to go into full detail in a paper of this kind. The whole secret lies in putting the machine in *good condition according to the facts we know and then maintaining it in that condition.* The writer feels we must do this to accomplish real fuel economy and that too little attention has been paid to locomotive upkeep in the past. The order must go out to let nothing interfere with keeping the motive power in prime, efficient condition. This will prove to be a move of utmost economy in the long run, as the following will witness.

On a certain district of a well known road, there was an engineman who knew his business operating what is known as a regular engine. The district foreman in charge of the engine was the engineman's son and, in order to please his father, he paid marked attention to the work that was done on this particular engine. As a result it was probably in a better condition than any other locomotive on that road. Then came an order placing that engine in the pool. Every engineman on the district then ran it in his turn and it received no more than the ordinary attention. But for a period of nearly two years thereafter it was known as the lightest fuel user on the district. As a result of being put in fine condition at the outset, it saved enough coal in the ensuing two years to pay many times over the initial extra cost of being put in that condition.

There is one item that must be touched upon, however, and that is the matter of sand for locomotive use, which perhaps should have been spoken of under Operation. At any rate, it has much to do with fuel economy and should receive more attention. Many a powerful locomotive has been allowed to spin and slip along for hours almost helpless, wasting coal and water—it takes fuel to pump water—for the want of a little sand under the driving wheels. On our heavy power, sand boxes should be enlarged and the best type of sander for the economical and sure use of sand be made a part of the engine equipment.

Sanding engines by hand is also a fuel waste because it takes an additional amount of coal to make up the long delay and, therefore, mechanical sanding devices should be maintained wherever sand has frequently to be taken on.

Policy of Improvement Too Conservative

On the whole, railroads have been just a little too conservative in adopting new and improved devices in engine operation to accomplish a great deal in fuel saving. Locomotives show less improvement for the time since being adopted for general transportation use than any other machine in general use for the same length of time. This has probably been due to two causes; first, the cheapness and plentifulness of fuel, and second, the difficulty inventors have encountered in getting new devices tried out. A more progressive policy should be now adopted and new inventions of promise be tried out carefully with a view to being put in use if practical or to developing them and remedying the faults of the inventor's idea.

I know of a case where a certain type of tank-valve was causing a fuel loss by reason of stopping up easily and interfering with the feed water supply. A new type of valve was given a thorough and exacting test lasting for seven months. It proved its superiority over the old valve in every particular but failed to be adopted on the road concerned because other roads serving the same territory were using the same old type and it was deemed best not to change for that reason.

This is illustrative of the attitude that must be gotten away from. If any improvement is to come, someone must cut a little red tape and do some pioneering.

What has been said under the heads of Operation and Mechanical pertains for the most part to train and engine

operation. While these are the principal fuel users, there are other departments where fuel is used, and, consequently, where fuel may be saved by the application of the two principles outlined—the saving of energy by the elimination of needless work and getting the most out of the fuel actually used. A light burned when not needed, a shaft running when not being used and heat turned on when more windows are opened than needed for ventilation are some of the many ways in which needless work is performed; an efficient boiler or steam plant, well maintained and fired by skilled men is one way of getting the most out of the fuel used. All departments should be watched by competent supervisors, all power waste eliminated and methods revised with a view to lessening the work performed wherever and whenever it can be done without loss of efficiency.

Personnel

Although, in looking into the question of fuel economy, consideration has been given first to the matter of operation and then to the mechanical features, it is not intended to convey the impression that they are of more importance than the human factor in this great problem. Given operating conditions that practically approach the ideal, given mechanical attention that is almost perfect, we shall still register a failure in accomplished results unless we have employees who are intelligent and who have attained that degree of skill and interest in their work that will cause them to take full advantage of every opportunity afforded to save fuel. In order that we may have a set of employees who will measure up to the required standard, it would seem that we must approach the subject in two ways, i.e., education and selection.

Education

As many of the men who will have to do with the saving of fuel are old employees already in the service, the method of selection cannot be applied to them and the effort will, necessarily, have to be confined to education. The older employees are naturally conservative, that is, they do not change the habits of a lifetime easily and, therefore, the effort to educate them, to induce them to drop the old, wasteful habits and to take up the newer, more economical ways, will have to be carefully considered lest it do more harm than good. The writer believes the subject should be handled by the use of gentle and constant persuasion rather than by disciplinary measures so far as the older employees are concerned. In the case of the new employee, such as firemen, brakemen, apprentices and all who enter the service where they may go to higher positions, the educational feature should be made compulsory by means of carefully graded progressive examinations relative not only to the particular line of work in which engaged, but also that which pertains to the saving of energy and fuel.

The story of coal, its origin and use, how its elements may be combined with those of the air to produce heat, how the different combinations produce the different gases with their varying degrees of heat when burned, reads like a romance if written in a simple manner, free from technical expressions, so that the ordinary reader may understand. If the problem of combustion could be written up by some authority in story form like Dr. Woods Hutchinson has written the story of many human ills for the Saturday Evening Post I am sure that the tale would be full of lasting interest for all employees, young and old, and would eventually result in the saving of many tons of fuel annually. As one of the means of saving fuel, let us see if we cannot find such a writer and then carry his story to every man having to do with the burning of fuel.

In the matter of compulsory fuel education among the younger employees, particularly enginemen and firemen, they

should be required to acquire a technical knowledge of combustion to a degree that will enable them to handle fuel in an economical way at all times and to know the reason for such handling. A large percentage of fuel waste is due to ignorance of the simplest laws of combustion. If we can dispel this ignorance and impart knowledge in its stead, this knowledge will cause action on the part of employees that will be almost automatic and which will go far in the matter of fuel saving. Men do not habitually do the things that they know to be wrong, so if we can educate them as to the right thing, they will, in course of time, almost unconsciously do that which is proper and right, which in this case, would be to handle fuel in a saving manner.

The educational features should be provided by the company and they should be carefully considered in order to make them as entertaining and as interesting as possible. Text books of easy grade, lectures, moving pictures, slides, etc., should be provided, as well as class instruction at regular and stated periods. These means of instruction once provided, there should be no hesitation in requiring those concerned to give full attendance and to keep up the required grades at the periodical examinations.

Selection of Employees

The writer believes that every railroad should have an employing department, the head of which should be an officer of general authority and who has been carefully, yes, very carefully, selected because of his knowledge and judgment of men. This officer should have assistants—not necessarily persons employed exclusively for this purpose, for many times an officer in other lines would meet the requirements—located in every terminal, whose duty it would be to keep in close touch with the youth in his community and who would talk to and register the names of those likely to make desirable employees. Then when the time came to increase the number of employees during seasonal rushes of business, the new men to enter the service could be taken from the selected lists instead of being grabbed haphazard from those happening to present themselves for employment.

It is my observation that once a person of the less desirable class is allowed to begin work, such person is rarely eliminated and the entire personnel of the road suffers during his or her term of employment. It is imperative that steps be taken to prevent the entrance of this class of labor.

For myself, I believe the time has come when some of the intelligence tests should be used in examining an applicant for service on our railroads. The Binet test and its modified forms, as demonstrated by its use in the Army, undoubtedly gives a very definite line on the native intellect of any individual and, given a high degree of mentality, education will easily develop a highly desirable worker. Lacking in primary intelligence, instruction may develop those qualities which the applicant has, but cannot increase the amount of mentality originally possessed. Intelligence is desirable in all classes of employment but is particularly needed in train service employees because they are often away from direct supervision and in time of stress must have that degree of thinking ability that will enable them to act on their own initiative, doing exactly the right thing and doing it quickly, if they are to be successful for themselves and for the road they represent.

While the idea of raising the standard of the personnel of a railroad is here presented with the thought in mind of saving fuel thereby, it should be apparent to all that the advantage gained will by no means be limited to that alone, but will permeate every line of activity of a transportation system.

The giving of prizes to those making the best records in fuel saving is not advocated. They are often awarded on a very narrow margin between worthy contestants, so narrow that chance or a slightly favorable advantage often determines the result. They are thereby almost disheartening

to those who failed to gain them, but whose effort was equally creditable. Small bonuses that can be earned by a majority of the employees concerned are, perhaps, more fair. But, then, the thought comes that if the conditions of award are such that the major portion can win, the minority, working under the same conditions and drawing equal compensation, should be *required* to earn the bonus. Thus it, too, becomes of doubtful value. If the need of a stimulus is felt, it had best be in the nature of profit-sharing in the savings effected. However, still better than this would be the investment of any amount available for gifts in a manner that would make for a still larger saving of fuel.

Summary

Summarizing, then, the following is offered as a means of securing the utmost in fuel economy:

Operation

Reduce grades where feasible. Generally, this is being done as rapidly as possible for other reasons than that alone of fuel saving.

Eliminate unnecessary car and engine mileage and terminal switching by the appointment of a committee on each railroad, headed by a general operating officer, to study these questions and put in effect all economies possible; the committees of connecting lines to meet to consider wasteful practices regarding deliveries of cars to each other.

Overhaul the system of comparative statements and accounts so as to present no incentive to make movements that consume fuel but do not give any actual earnings. Do away with making certain overcharges to counterbalance shortages. Let the shortage show and make every effort to eliminate it, frankly acknowledging that which cannot be overcome. Make every fuel charge true and exact so that the records will mean something.

Give careful attention to the make-up of train schedules, calling in representative engineers and conductors on the districts under consideration to give advice as to the proper distribution of time, so the run may be made with the least effort.

Overhaul and rebuild locomotives during the slack season. Discontinue the practice of keeping a locomotive in service until a certain number of miles have been made regardless of excessive consumption of fuel due to worn out fireboxes, flues or machinery.

Organize fuel committees—or maintain them where already organized—one for each terminal, composed of local officials and a member from each branch of the service, meetings to be held at stated intervals to receive fuel saving suggestions, act on them and see to the enforcement of those adopted; one or more delegates from each terminal committee together with division officials to form the next higher or division committee to handle fuel matters that are beyond the jurisdiction of the terminal committees, the whole to be headed by a central fuel committee, composed of general officers, this committee to make findings in all cases that have failed of disposition in the lower committees and to have general jurisdiction over all.

Mechanical

Maintain locomotives in prime condition, paying particular attention to cylinders, pistons and cylinder packing; valves, rings and cages, as to fit; keeping the valves square; allowing no leaks either in firebox or front ends; keeping front ends airtight. Use the brick arch in firebox wherever possible.

See that tenders have sufficient coal carrying capacity without being loaded to a point where coal falls off to be wasted. Keep decks in smooth, level condition so the fireman may easily get just the amount of coal wanted on the scoop.

Maintain a stop board on the right side of the shoveling sheet to keep coal from spilling out the gangway.

Water valves in injectors should have stems packed tight enough so they will stay where set. Feed water supply under perfect control makes for less fuel consumption and, in this connection, the use of one injector that has sufficient capacity to supply the boiler is more economical than the use of both where this is frequently necessary. In the one case the supply is steady and easy to fire against; the other requiring "slugging" to overcome uneven supply.

Draft appliances and grates should be of such design and adjustment as will best take care of the particular kind of fuel being used; boilers and flues kept free from scale; the latter also to be kept free from soot by frequent cleaning.

Where roundhouse facilities are short, additional house room should be provided as soon as possible. Enormous quantities of coal are uselessly consumed keeping engines alive and from freezing up during cold weather when they must be kept out of doors awaiting orders.

Close touch should be maintained between yard masters, train dispatchers and roundhouse forces to avoid getting engines under steam a long time before they are needed.

Heating and power plants should be of a size that will give the required supply without being forced, skillfully fired and well maintained. The dense black smoke rolling from most of the railroad plants indicates that (a) the plant is being forced, (b) is not being fired properly or (c) is in poor condition; any or all of which should be remedied.

All kinds of steam leaks should be stopped. They are frequently found on passenger trains, locomotives, heating plants—in fact, wherever steam is used.

Lights of all kinds consume fuel. See that none is in use when not needed. Have plenty of ventilation for health's sake but do not try to heat all outdoors during cold weather.

Education and Selection of Employees

Both old and new employees must be taught the rules of fuel conservation and be required to use them and obey their teachings. Persistent carelessness in the use of fuel should be treated the same as any other infraction of the rules.

The best means of instruction should be provided by the company and pains taken to make it pleasant for the employees required to take it. It should be made available at convenient hours, interfering with their earning time not at all, and with their recreation hours as little as may be consistent with the knowledge they must acquire.

Firemen and the younger engineers and shop apprentices in the machine and boiler departments should be required to have some technical knowledge of the science of combustion. This is equally desirable on the part of the older employees, but making it a rigid requirement would probably cause a degree of hardship that should be avoided. The situation, as to the old employees, will soon work itself out satisfactorily as they will gradually leave the service and, while in the service, they will pick up and use much of the fuel knowledge of the younger men.

The education of the younger and new employees should not be left to chance. Their remaining in the service should be dependent on attaining certain markings as to grade, these markings to be determined by periodical, progressive examinations.

Prospective employees should be selected in advance of their employment by means of an employing department. This does not mean that experienced men are not to be taken on as new employees. On the contrary, they are often valuable acquisitions to the service but should be required to pass the same requirements as new men and, furthermore, they should furnish satisfactory personal as well as railroad references.

New employees should be taken on probation with the understanding that they are in no sense a permanent part

of the organization unless they show an aptitude for the work. It is an injustice to the individual as well as to the railroad to allow him to continue long in the service as a square peg in a round hole. Lack of success as a railroad man does not necessarily denote lack of ability and many a railroad failure has been highly successful in other lines.

Consequently, both should be willing to sever connections for the good of each other.

Prizes and bonuses for excellent fuel records are to be discouraged.

The writer has faith in the use of an intelligence test in employing new men.

Service of 50 Per Cent Cut-off Locomotives*

The Simplicity of Two Cylinders Combined With Advantages of Compound and Three Cylinder Types

By W. F. Kiesel, Jr.

Mechanical Engineer, Pennsylvania System

THE 50 PER CENT cut-off locomotive may be defined as one which, in expansion ratio, approximates the compound locomotive, in uniformity of torque practically equals the three-cylinder locomotive, and in simplicity of parts is the same as an ordinary two-cylinder locomotive. The advantages which it provides are materially lower water rates and hence lower coal rates per indicated horsepower. The maintenance cost will be no greater; in fact, it may be slightly less on account of more uniform torque.

Since for certain advantages in any mechanism, it is usually found that there are certain features not so good as in the mechanism replaced, it is natural to inquire what is sacrificed. The piston pressure will have to be at least 25 per cent greater than for a locomotive with 90 per cent cut-off, which involves an increase in weight of reciprocating parts and counter-balance. This cannot be avoided. When the locomotive comes to rest with such a crank angle that all of the steam for starting must pass through only one of the auxiliary ports, it will take about half a minute in the worst case to build up pressure equal to boiler pressure in the cylinder. This does not happen with sufficient frequency to be taken into account on road engines.

The functional design features which differ from the ordinary locomotive and which involve little difference in cost and weight, are an increase of steam lap on the valve, a small auxiliary port cut through the valve bushing—one at each end of the steam chest—and a change in the ratio of the lap and lead lever to suit the increased lap.

Based on operation on the road, the average saving of steam in heavy service is at least 20 per cent. If an 80 per cent boiler is used, the coal saving should also be 20 per cent, but with a 100 per cent boiler the coal saving will be greater.

The increase of reciprocating weights, which is the only factor of a negative nature that need be considered, will be closely proportional to the increase of piston pressure. The revolving weights for the main wheels will also be increased, since the back end of the main rods and the main crank pins must withstand the increased piston pressure. The side rods, being designed to slip the drivers, require no modification as the weight on drivers need be no greater. These weight increases amount to about $1\frac{1}{8}$ per cent of the total weight of a heavy Mikado locomotive.

If the increased piston pressure is obtained by increasing the boiler pressure, the weight of the boiler will be increased by an equal amount. To keep the same weight of locomotive, there will have to be a reduction of $1\frac{1}{8}$ per cent if the pressure is not increased, or of $2\frac{1}{4}$ per cent when the pressure

is increased, which will necessarily have to be taken from the size of the boiler. A reduction of 10 per cent in heating surface and the other features governed thereby, will fully meet this requirement.

From experience with simple engines, we know that the lowest water rates obtain between 20 per cent and 50 per cent cut-off. We also know that for starting, a cut-off of at least 80 per cent should be available. Train resistance, which the power of the locomotive must overcome, is large for starting, but drops quickly with increase of speed up to about $2\frac{1}{2}$ miles an hour, and then gradually increases with increasing speed. The auxiliary port permits a cut-off of 80 per cent, but being restricted in size, its effect begins to diminish immediately after starting and to a large extent is neutralized by wire-drawing at about $2\frac{1}{2}$ miles an hour.

Fuel and Water Rates

The formula for the pulling power of a locomotive consists of a coefficient representing the per cent of boiler pressure P available as mean effective pressure, which may be represented by the letter C and the engine constant $PD^2L \div W$, which may be represented by the letter Y . The coefficient C is governed by the expansion ratio E and when drawbar pull for starting is involved, it is customary to use 90 per cent of the value that would obtain for theoretical calculations, based on the work done in the cylinders. For simplification P will represent gage pressure and not absolute pressure in this discussion. Drop in pressure, effect of cylinder clearance and back pressure will not be included. This procedure will not affect the results materially, since we are dealing with comparisons. These comparisons shall cover locomotives of the same type, weight and power, which will permit ignoring engine resistance, and base power comparisons on cylinder work only.

The formula for tractive force referred to above is $T = CY$. The value of C for the drawbar pull of a simple locomotive in starting is universally taken as .85. For tractive force, based on work in the cylinders (not at the

drawbar) $C = \frac{2}{E + 1}$. For a cut-off of 90 per cent, $E = 1.111$, whence $C = .947$. Similarly, for cut-off of 80 per cent, $C = .889$, and for 50 per cent, $C = .667$.

The increase of 25 per cent in the value of Y for the 50 per cent cut-off locomotive may be obtained either by increased cylinder dimensions, or by increased pressure, or by both.

The following assumptions are based on data, which is indicative, but not conclusive: For a locomotive with 90 per cent cut-off, C is .947 for starting, and at about $12\frac{1}{2}$ miles

*From a paper read before the New York Railroad Club, November 16, 1922.

per hour it is .85. For the 50 per cent cut-off locomotive, it is .889 for starting, .80 at $2\frac{1}{2}$ miles per hour, and .667 at about $12\frac{1}{2}$ miles per hour.

To clearly show the difference between the two principles, in concrete form, let us assume the design of a Mikado locomotive to weigh 320,000 lb. in working order, which will have 90 per cent cut-off, 27-in. by 30-in. cylinders, 200 lb. boiler pressure and a maximum evaporation of 50,000 lb. of water per hour.

From formulations given by Professor Arthur J. Wood of Pennsylvania State College, in his book entitled *Locomotive Operation and Train Control*, the calculated formula for tractive force when worked to full boiler capacity for this locomotive is $T = 1,356,486 \div (10.121 + V)$, in which V = speed in miles per hour. The corresponding 50 per cent cut-off locomotive of equal weight would have 250 lb. boiler pressure, and a maximum evaporation of 45,000 lb.

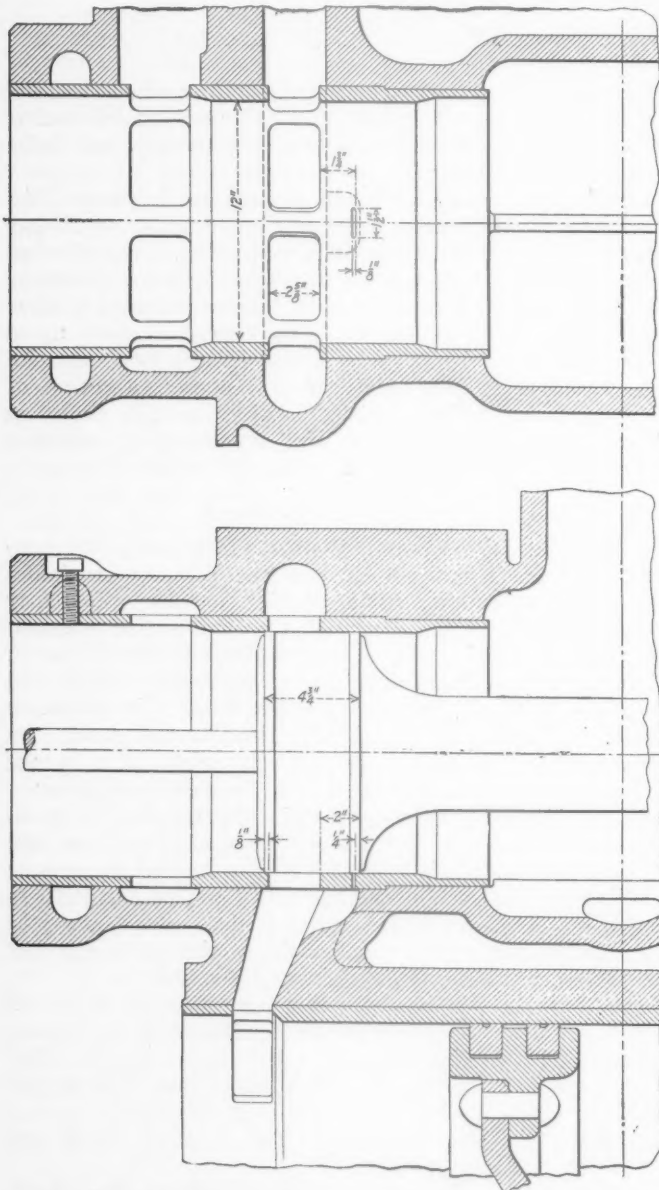


Fig. 1—Location of the Auxiliary Port in the Valve Bushing

of water per hour. Its calculated formula for tractive force would be $T = 1,261,440 \div (7.451 + V)$.

Fig. 2 shows these tractive effort curves for comparison. The transition curve connecting the line for less than boiler capacity with the full boiler capacity line is empirical.

For full gear operation, when hauling heavy loads, it is

readily seen that the relative steam consumption of the 50 per cent cut-off locomotive is $1.25 \times .50 \div 90$, or .694, a saving of 30.6 per cent of steam. For such operation, this would permit making the boiler 30 per cent less in value than that of the ordinary locomotive. Since on the equal locomotive weight basis it need only be 10 per cent less the excess boiler, for slow freight full-gear operation, will produce a coal saving greater in per cent than the water saving.

The water saving indicates that the 50 per cent cut-off

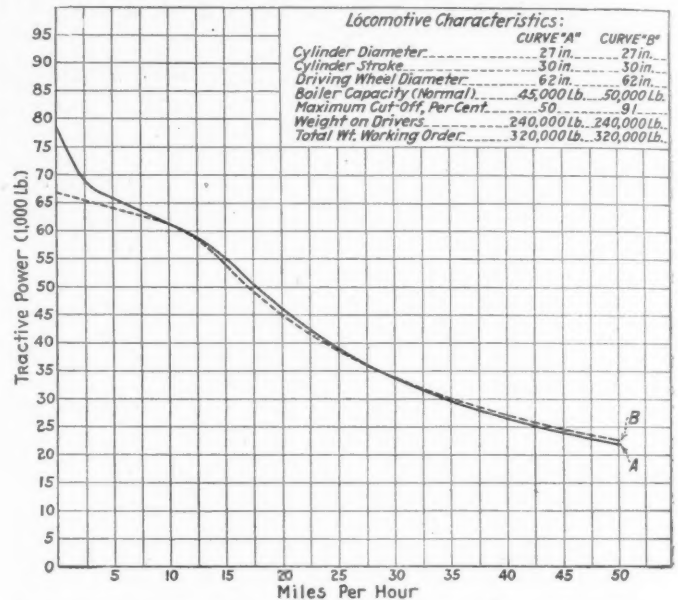


Fig. 2—A Comparison of the Tractive Force Produced by Locomotives, One with Full Stroke and the Other with Fifty Per Cent Maximum Cut-Off

locomotive working in full gear can go 44 per cent further before it must stop to take on water. From the tests of the Decapod 50 per cent cut-off locomotive, the formula developed for the ratio of the water rate to the coal rate is $W \div C = 10.622 - .000104125W$. This formula will answer for the comparison we wish to make, because the coefficient of the second term varies inversely as the value of the heating surface. The comparative formulæ would then be for the ordinary locomotive, $W \div C = 10.622 - .000104125W$, and for the 50 per cent cut-off locomotive, $W \div C = 10.622 - .0001157W$.

If $W = 50,000$ for the ordinary locomotive and 30.6 per cent less, or 34,700 for the 50 per cent cut-off locomotive, $W \div C$ for the former is 5.42 and 6.61 for the latter, indicating a coal consumption for the latter of 57 per cent of that of the former, or a saving of 43 per cent, or an increased radius of operation, before taking on coal of 75 per cent. This is the extreme economy, which cannot be realized as an average in any kind of service, except possibly in shifting service.

Let us now investigate the water and coal saving, when both locomotives are working to full capacity at 20 miles per hour. For this speed, the formulæ for tractive force give 45,034 lb. for the ordinary locomotive and 45,952 lb. for the 50 per cent cut-off locomotive, which, therefore, furnishes slightly more power with 10 per cent less steam and coal. By placing the values for T for the two locomotives equal to each other in the formulæ for tractive force and solving for V , it will be found that the 50 per cent locomotive with a 90 per cent boiler will furnish more power for all speeds up to 28.46 miles per hour, at which speed they are equal in power, but the former uses 10 per cent less fuel and water.

Torque

The torque for the 50 per cent cut-off locomotive is practically as uniform as that of a three-cylinder locomotive with crank axle. A careful analysis of the ratio of maximum to minimum tangential pressure for a three-cylinder and a two-cylinder locomotive, both with 50 per cent cut-off, resulted in a ratio of $126\frac{1}{4}$ per cent for the former and $126\frac{2}{3}$ per cent for the latter. Another analysis for the same ratio for two-cylinder simple locomotives, one with 90 per cent cut-off, and the other with 50 per cent cut-off, and main rods $7\frac{1}{3}$ times the length of the crank arm, resulted in a ratio of 158 per cent for the former and 131 per cent for the latter.

Figs. 3 and 4 show the tangential turning force exerted on the wheels of the Mikado locomotive, assuming a ratio of length of main rod to crank of 8.6. Fig. 3 represents that for the 90 per cent cut-off locomotive, giving a maximum torque of 125.3 per cent, and Fig. 4 that for the 50 per cent cut-off locomotive, giving a maximum torque of 113.6 per cent. For the latter this would permit an increase in cylinder pressure of 10 per cent without increasing the danger of slipping.

No hard and fast rules can be formulated on account of variations in main rod and crank lengths, but from studies thus far concluded, the indications are that the ratio of maximum to minimum tangential pressure is at least 20 per cent greater at 90 per cent cut-off than at 50 per cent cut-off. At speed, for earlier cut-off points, the uniformity of torque depends mainly on careful arrangement of the valve events, based on the weight of reciprocating parts.

Uniformity of torque decreases the possibility of slipping, and tends to decrease the wear and tear of the machinery to some extent. Consequently, the ratio of cylinder tractive

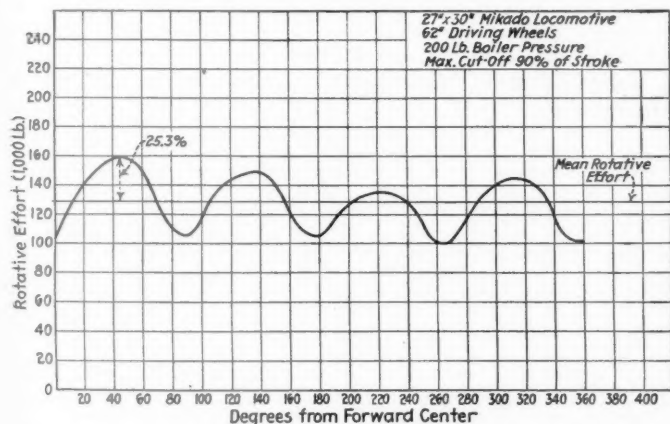


Fig. 3—Tangential Force Curve for Locomotive with 90 Per Cent Maximum Cut-Off

effort to weight on drivers may be increased, or with the same ratio, the slipping will be materially decreased.

We may expect an average saving of about 20 per cent in favor of the 50 per cent cut-off locomotive for slow speed and heavy service; a saving of 10 to 15 per cent in fast freight service, and a saving of nearly 10 per cent for medium loads and high speeds.

The increased reciprocating weights must be given due consideration. For slow speed, the effect thereof is of little importance. For high speed, these increased weights are much more important. For high speed passenger service, it may be assumed that the negative effect of the 25 per cent increase of reciprocating weights balances the positive effect of a possible 10 per cent saving in coal and water.

On the other hand, when considering slow speed freight service, the effect of increase in reciprocating weights is negligible and the saving of 20 per cent of coal becomes paramount.

Four or five years ago extensive tests were made of a 50 per cent cut-off locomotive on the locomotive test plant at Altoona, Pa., which were described in Pennsylvania Test

Department Bulletin No. 31.* The locomotive tested was a 2-10-0 type designed to be capable of furnishing 25 per cent more power than the 2-8-2 long cut-off locomotive, with which it was compared. Both locomotives were hand fired, were equipped with Type A superheaters, and had no feedwater heaters. These locomotives may be compared for economy, which is not affected by capacity. The maximum thermal efficiency for the 2-8-2 was 7 per cent and for the 2-10-0 was 8.1 per cent.

In the tests of the 2-8-2, including only four tests above 60 per cent cut-off and none in full gear, the average coal per indicated hp. was 2.83 lb. In the tests of the 2-10-0, of which 30 per cent were at 45 per cent and greater cut-off, the average coal per indicated hp. was 2.57 lb., a decrease of 9.2 per cent, on a basis very unfavorable to the 2-10-0. This shows that, under adverse conditions for the 50 per cent

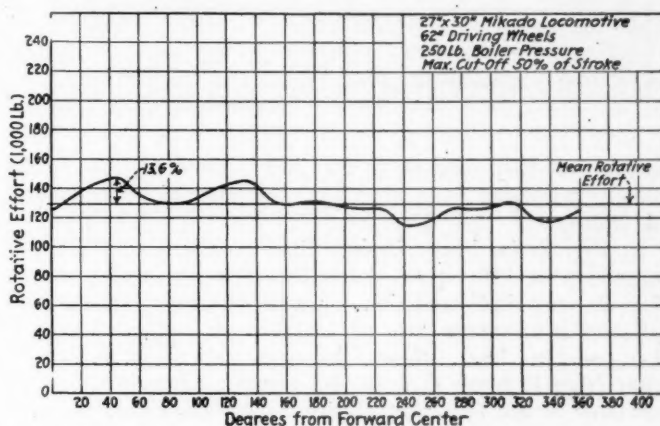


Fig. 4—Tangential Force Curve for 50 Per Cent Cut-Off Locomotive

cut-off locomotive, it still shows a material saving over the long cut-off locomotive at its best points of operation.

The advantages in economy of the 50 per cent cut-off locomotive can best be seen from Figs. 5 and 6, copied from Bulletin No. 31, on which the steam rates at 140 r.p.m. have been transferred from Fig. 6 to Fig. 5 and, correspondingly, the 40 r.p.m. line and the full gear cut-off line from Fig. 5 to Fig. 6. The full gear cut-off line is marked "55 per cent cut-off" because it represents a higher mean effective pressure than would be realized at 50 per cent cut-off.

The following remarks relate only to values between 40 r.p.m. (7.38 miles per hour), and 140 r.p.m. (25.83 miles per hour) and tests at water rates not less than 30 per cent of boiler capacity. From Fig. 5 it will be noted that the highest water rate per indicated horsepower is 19.5 lb., which rate cannot be exceeded with the 50 per cent cut-off locomotive regardless of how the locomotive is operated. From Fig. 6 it will be seen that a water rate per indicated hp. of 31.8 lb. can be reached with the 90 per cent cut-off.

Slow freight locomotives are often operated for extended periods of time in full gear and shifting locomotives are seldom operated otherwise than in full gear. It is customary to provide shifting locomotives with relatively larger grates on this account. From these tests, it is clear that a 50 per cent cut-off shifter should save at least one-third of the water which would be used by a long cut-off shifter. This would increase its radius of operation per unit of water by 50 per cent, would permit reducing the grate area by more than one-third, and, if the boiler is not otherwise changed, would increase the water evaporation per pound of coal for the same power by 25 per cent. The coal saving would be more than 45 per cent. At higher speeds and other cut-off points, the saving in water and coal is less.

From these diagrams it is possible to compare any kind of operation and determine the economy. The important

*For a description of these tests see the *Railway Mechanical Engineer* for April, 1920, page 193.

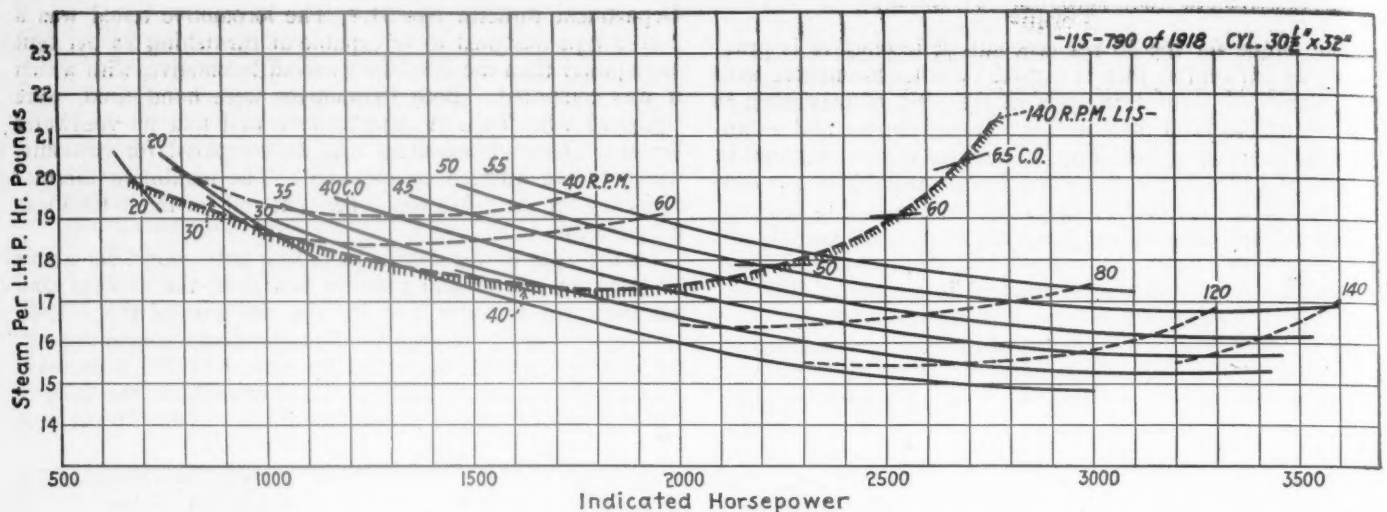


Fig. 5—Water Rates of a Decapod Locomotive with Fifty Per Cent Maximum Cut-Off Compared with the Water Rate of a Mikado Locomotive of the Ordinary Type at About 26 Miles an Hour

feature that they disclose is that the locomotive crew is absolutely prevented from working at uneconomical water and coal rates.

In Fig. 5 the heavy broken line, representing the 2-8-2 locomotive at 140 r.p.m. shows that the best water rate is 17.3 lb. per indicated hp. Correspondingly, the 2-10-0 indicates a minimum rate of 15.3 lb. per indicated hp., or 11.6 per cent less. Hence the tests indicate a saving of water from 11.6 per cent to 38.7 per cent, showing that the estimates in the fore part of this paper are conservative.

The actual coal saving is dependent on the value of the boiler used on the locomotive. It will be apparent that, in nearly every case, an oversize boiler can be utilized. This would result in a coal saving greater in per cent than the

water saving. The boiler for the 2-10-0 locomotive tested is an undersize boiler. The minimum coal rate for the tests was 2 lb. per indicated hp.-hr. The coal rate did not exceed 3 lb. per indicated hp.-hr. for all water rates less than 52,000 lb. per hour.

Later locomotives of this type were equipped with the Type E superheater, a feed water heater, and a stoker. Tests have been made, but the report has not been completed. The use of the Type E superheater in the same boiler results in greater heating surface. A number of tests showed a coal rate less than 2 lb. per indicated hp.-hr., the lowest being 1.79 lb., or 10 per cent less than the best performance of the hand-fired locomotive with the Type A superheater.

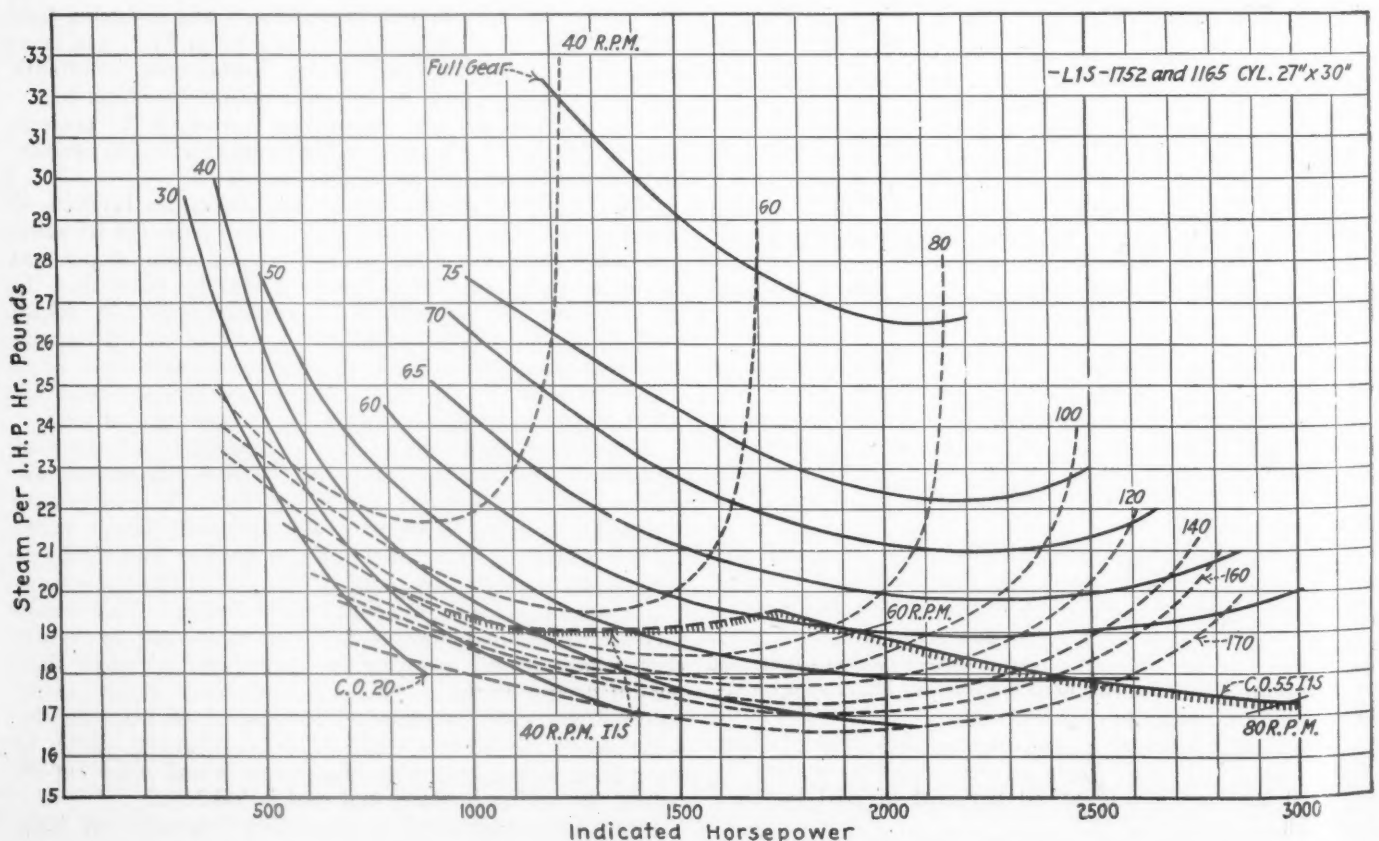
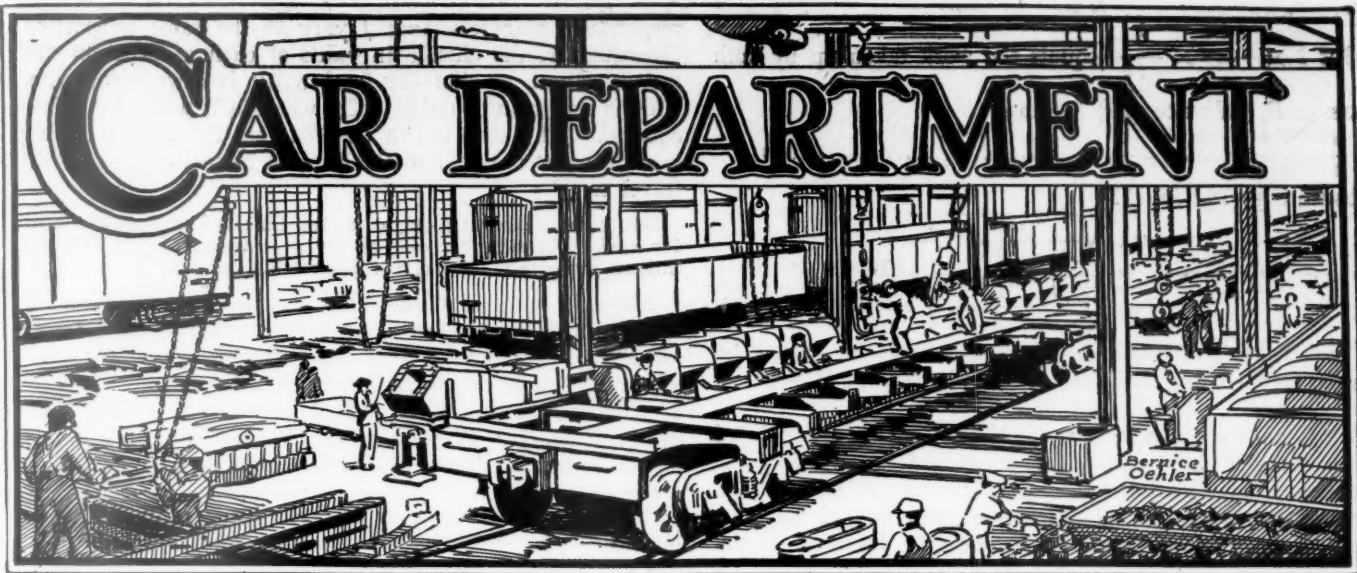


Fig. 6—Water Rates of a Mikado Locomotive of the Full Stroke Cut-Off Type Compared with Those of a Decapod of the Fifty Per Cent Maximum Cut-Off Type at Seven Miles an Hour and at Higher Speeds with Maximum Cut-Off



A Mathematical Law of Impact Between Cars^{*}

Conclusion of a Study of the Time of Draft Gear Closures Which
Began in Last Month's Issue

By E. M. Richards

AT the conclusion of last month's installment, it will be remembered that, by substituting equation (6) in equation (7) and simplifying, we had arrived at

$$\frac{dx}{dt} = \sqrt{\frac{6g(W_a + W_b)}{W_a W_b}} (F's' - fx)$$

Before this expression can be used in integration, the variable f must be expressed in terms of x . This can be done as shown in Fig. 2, from the triangular relation that the force f at any travel x is to the maximum force F^1 , for a given impact, at the corresponding maximum travel s^1 (not necessarily the maximum possible travel of the gear) as x is to s^1 . That is

$$\frac{f}{F'} = \frac{x}{s'}$$

Or

$$f = \frac{F'x}{s'} \quad \dots\dots\dots (9)$$

Substituting (9) in (8)

$$\frac{dx}{dt} = \sqrt{\frac{6g(W_a + W_b)}{W_a W_b}} \left[F's' - \frac{F'}{s'} x^2 \right]$$

$$\frac{dx}{dt} = \sqrt{\frac{6gF'(W_a + W_b)}{W_a W_b s'}} \left[(s')^2 - x^2 \right]$$

We now have a differential equation in terms of the gear

^{*}Since the publication of the first installment of Mr. Richards' article, he has called our attention to two typographical errors in the equations as they appeared in the November issue. Near the top of page 762, where equation (2) is substituted in equation (1), the first parenthesis inside the bracket was misplaced. The equation should read:

$$\frac{dx}{dt} = 6 \left[\frac{dS_a}{dt} - \left(\frac{W_a V_a + W_b V_b}{W_b} - \frac{W_a dS_b}{W_b dt} \right) \right]$$

In equation (6), shown in the middle of the second column of the same page, two equations are shown as one continuous equation. These should have read as follows:

$$W_a W_b (V_a^2 - 2V_a V_b + V_b^2) - \frac{gF's'}{6} (W_a + W_b) \cdot$$

$$(V_a - V_b)^2 = \frac{gF's'}{6} \frac{W_a + W_b}{W_a W_b} \quad \dots\dots\dots (6)$$

travel x and time t which can be put into shape for integration, thus

$$\int_0^t dt = \sqrt{\frac{W_a W_b s'}{6gF'(W_a + W_b)}} \int_0^{s'} \frac{dx}{\sqrt{(s')^2 - x^2}}$$

$$t = \sqrt{\frac{W_a W_b s'}{6gF'(W_a + W_b)}} \left[\sin^{-1} \frac{x}{s'} \right]_0^{s'} \quad \dots\dots\dots (10)$$

$$t = \sqrt{\frac{W_a W_b s'}{6gF'(W_a + W_b)}} \left[\sin^{-1} \frac{s'}{s'} - \sin^{-1} 0 \right]$$

$$t = \frac{\pi}{2} \frac{1}{\sqrt{6g}} \sqrt{\frac{W_a W_b}{W_a + W_b} \frac{s'}{F'}} \quad \dots\dots\dots (11)$$

Now the maximum gear travel, s^1 , of the given impact is to the maximum possible travel of the gear s , as the maximum resistance of said impact is to the resistance of the gear at its maximum possible travel s , viz.,

$$\frac{s'}{s} = \frac{F'}{F} \text{ or } \frac{s'}{F'} = \frac{s}{F}$$

Substituting this and also $\frac{\pi}{2} \times \frac{1}{\sqrt{6g}} = .113$ in (11)

$$t = .113 \sqrt{\frac{W_a W_b}{W_a + W_b} \frac{s}{f}} \quad \dots\dots\dots (12) \quad \dots\dots\dots \text{Formula}$$

This formula may also be expressed in terms of work taken up by the gears. To accomplish this, the numerator

and denominator of the fraction $\frac{s}{F}$ may be multiplied by

$$2 \times 2 \times s \times 12, \text{ thus}$$

$$\frac{s}{F} = \frac{2 \times 2 \times s \times 12 s}{2 \times 2 \times s \times 12 F} = \frac{s^2}{2 \times \frac{sF}{2} \times \frac{1}{12}} \quad \dots\dots\dots (13)$$

But $2 \times \frac{F}{2} \times \frac{1}{12}$ equals the work taken up by both gears, or E . Whence (13) becomes

$$\frac{s}{F} = \frac{1}{12} \frac{s^2}{E} \quad (14)$$

Substituting (14) in (12)

$$t = .113 \sqrt{\frac{W_a W_b}{W_a + W_b} \frac{s^2}{12E}}$$

$$t = .0327 s \sqrt{\frac{W_a W_b}{(W_a + W_b)E}} \quad \text{.....(15).....Formula}$$

The dependability of these formulæ may be tested by comparing the values computed therefrom with the U. S. R. A. test results.

To secure such comparison, the times have been calculated with equation (15). This has been used in preference to equation (12) because the former, due to the quantity E , covering the whole period of closure, tends to average gear curve irregularities, whereas equation (12) does not, as the

evaluation of the latter depends upon the ratio $\frac{s}{F}$, which ratio obtains at the end of full gear travel and which may be entirely different on earlier portions of the curve.

This equation (15), by using the values of 143,000 pounds for W_a and W_b , as given on page 82,* may be simplified to

$$t = .0327 s \sqrt{\frac{143,000 \times 143,000}{143,000 + 143,000} \frac{1}{E}}$$

$$t = \frac{8.72 s}{\sqrt{E}} \quad \text{.....(16)}$$

The values of E used in equation (16) are one-half of those in column 19, pages 122 and 123. These halved values are taken because substantially half of the kinetic energy in the striking car just before impact is taken up by the gears and car bodies at maximum gear travel, for the conditions obtaining in the U. S. R. A. tests. The value of E thus used includes the work done by the car bodies, as already mentioned, which work must be considered, as the car bodies do their share in influencing the time of compression. For the same reason s is taken in the formula as the sum of the yield of the car bodies and the full gear travels; that is, it is the average of the values in columns 12 and 13 plus one-half the values in column 14 on pages 122 to 123.

In this manner were obtained the computed times in Table II. In comparing these with actual test values, it should be remembered that the formulæ were developed from a straight line relation between gear resistance and gear travel, as shown by curve *a* of Fig. 1, that the curves of most of the gears do not follow this relation, and that the more they deviate therefrom, the more the two sets of values must be expected to disagree. Notwithstanding these factors, however, it can be seen that in most cases the calculated and test figures check within a few per cent. Accordingly, the reliability of the formulæ is established.

The foregoing formulæ, in addition to furnishing a means of closely calculating time of gear closure, also reveal some very interesting facts about impact.

Gear Travel

For given gears in given cars, the times of all maximum gear closures, whether partial or full, are the same when the resistance-travel curve is a straight line.

This is evident from the following: Equation (11) contains the quantity s , any maximum gear travel for a given impact. As shown in equation (9), however, s and its cor-

responding gear resistance f vary in the same proportion; consequently, the change in value of each at different gear travels cancel, so that the final result is always the same. This is shown in equation (12), where it is worked out from equation (11), and it can be seen that the time t for any gear travel s is equal to the time to close the gear at full travel s .

For given gears in given cars, the times of maximum closure for various impacts decrease as the gear travel of the respective impacts increase when the travel-resistance curve is upward.

Since, in a straight line relation, where the resistance increases in direct proportion to the gear travel, the time for all degrees of maximum gear closure are the same, as already shown, it stands to reason that when the resistance increases at a greater rate than the travel, as when the curve bends upward, the time of closure for different impacts must decrease as the maximum gear travel increases.

For given gears in given cars, the time of maximum closure for various impacts increases as the gear travel of the respective impacts increase when the travel-resistance curve is downward.

This is self-evident, as it is the opposite of the conditions of the preceding paragraph.

The relation between time and distance of travel to different points along the path of gear travel during a particular impact follows substantially a sine curve.

This is shown by equation (10) and the movement-time curves of the U. S. R. A. tests. This statement must not be confused with the preceding discussion. The present statement concerns the relation between the distance from the start of gear travel up to the various points it passes on the way to maximum gear travel and the time to reach said points during any given impact; the preceding discussion covers a comparison of the times to reach the various maximum gear travels (not necessarily full gear travel) at various impacts and has nothing to do with the time to reach the points passed over on the way to these maximum travels. Naturally, on a particular impact, the gear comes to half maximum travel sooner than the maximum travel itself. As evident from equation (10), the time to reach the half-way point is to the time to come to the maximum point itself as

the sine⁻¹ $\frac{1}{2}$ is to sine⁻¹ 1, or $\frac{\pi}{6}$ to $\frac{\pi}{2}$. Only when the resist-

ance-travel curve is a straight line, however, is the above-mentioned relation a true sine curve.

Car Weight

For given gears in given cars, the heavier either car is made, the longer the time of maximum gear closure.

This can be seen from the expression $\sqrt{\frac{W_a W_b}{W_a + W_b}}$ in equations (12) and (15). This relation in Fig. 3 is shown with W_a as abscissæ (horizontally) and the comparative time

of closure as ordinates (vertically) on the basis of $\sqrt{\frac{W_a}{W_b}}$

= 1 when both W_a and W_b are 40,000 lb.; the curves are for car B with weights of 40,000 lb., 90,000 lb. and 140,000 lb., respectively. To prove the above statement, take car B with a weight of 40,000 lb. and car A with 40,000 lb. According to the curve, the ratio is 1; with the weight of car B remaining at 40,000 lb. and that of car A increased to 140,000 lb., the ratio increases to 1.25. In other words, with this increased weight, the time of closure increases 25 per cent.

For given gears in given cars, with the sum of the weights of both cars remaining constant, the time of closure of a given gear is longest when the weight is equally divided between the two cars.

*This and other similar references in this article are to the pages of the Report of Draft Gear Tests, published in 1921, by the Simmons-Boardman Publishing Company, covering the U. S. R. A. tests.

This can also be seen from Fig. 3. Take the above case with car A weighing 140,000 lb., car B 40,000 lb. and the ratio 1.25. If this weight be equally divided between the cars, each will weigh 90,000 lb. and the curves then show the ratio to be 1.50. In other words, the time increases in the ratio of 1.50 to 1.25. This, together with a number of similar examples, will bear out the statement preceding this paragraph.

For given gears in given cars, the weights of the cars may be interchanged without affecting the time of gear closure.

This is self-evident from the expression $\sqrt{\frac{W_a W_b}{W_a + W_b}}$. It should be noted that, as just mentioned, a change in car weight changes the time of draft gear closure, but, as previously proved, the time for all degrees of closure for a given gear are substantially the same for any particular combination of car weights.

Car Velocity

Car velocities have no influence upon the time of closure.

It will be noted that the mathematical considerations were started by ascribing any velocities V_a and V_b to car A and car B and these velocities soon dropped out of the mathematical expressions, indicating that they had no bearing on the closure time. Stated in other terms, both cars moving around 5, 25, or 50 m.p.h. have the same time of draft gear closure. Similarly, the velocity difference between the cars does not influence the closure time. The greater the velocity difference between cars, of course, the farther in the gears will be driven; but as already proved, the times of gear travels, whether much or little, are substantially the same in each instance. These statements concerning car weight and car velocity are only approximately correct.

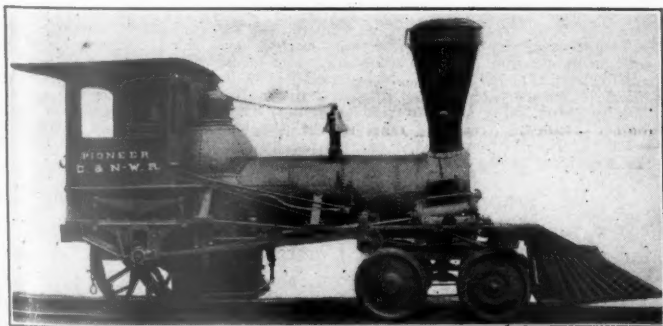
Conclusion

This concludes the studies of the present article. It is worth noting in this connection that all that has been stated concerning impact between cars applies equally well to impact between any two bodies, and, consequently, that this article is in reality a study of impact in the broad realm of general physics itself.

It should be noted further, that for the first time are given herein formulæ for calculating the time of gear closure, a classification of the effects of the dynamic resistance-closure relation of car weights and of car velocities on this time and the comparative times of movement to various points along the path of gear travel during any particular impact.

To the railway man, in particular, the foregoing should prove helpful in studying actions in short and long trains, both with and without the brakes applied, and to the draft gear manufacturer, quite valuable when contemplating gears of new design.

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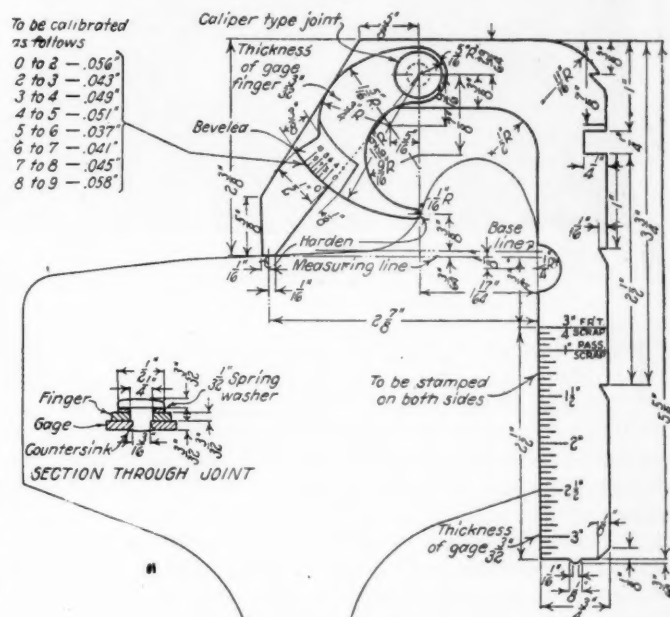


The North Western "Pioneer," First Locomotive to Enter Chicago; It Arrived on Board the Brig "Buffalo" on October 10, 1848

New Standard Gage for Steel Wheels

THE Committee on Wheels of the Mechanical Division of the American Railway Association, in its report presented at the 1923 meeting of the division, recommended the adoption of a new gage for the measurement of service metal on wrought steel wheels to take the place of the then standard gage, which has not been found satisfactory. The methods of application of the gage proposed by the committee were clearly illustrated on pages 458 and 459 of the July *Railway Mechanical Engineer*, in which appeared the report of the Wheel Committee.

In Circular No. DV 321, issued on November 26, 1923, the Mechanical Division announced that this gage had been approved by letter ballot and that the necessary changes in the Interchange Rules, required in connection with its use,



STEEL WHEEL GAGE
for use in measuring tread thickness, amount of metal to be turned off tread to restore flange contour, and limit of depth and location of witness groove in flange, slid flat spots, vertical flanges, chipped rims and axle collar thickness

Form of Steel Wheel Gage Recently Adopted by Letter Ballot.
The Use of This Gage Is Required by Interchange Rules Effective January 1, 1924

have been made and will become effective January 1, 1924. The circular calls attention to the fact that measurements of service metal on wrought steel wheels for billing purposes must be made with the new gage, or an approved equivalent, from January 1, 1924, before which time it will be necessary for the members to supply themselves with these gages.

The gage may be secured from commercial manufacturers of gages, or may be manufactured by the railroads themselves. Some slight modifications have been made in the form of the gage since the publication of the report of the committee. The illustration shows in detail the present standard form as adopted by letter ballot.

THE UNION PACIFIC has recently been running locomotives on passenger trains, through, between Kansas City, Mo., and Denver, Colo., 640 miles, where four engines had been required. Prior to the change four light Pacific type locomotives were used on 15-coach trains with changes at Junction City, 140 miles from Kansas City; Ellis, 163 miles farther, and Sharon Springs, 127 miles; thus leaving a run of 210 miles into Denver for the fourth locomotive. The light type Pacific engine has been replaced by a heavy type.

Car Inspectors and Car Foremen Compare Notes

1923 Convention Listens to Inspiring Addresses and Discusses Billing and Interchange Rules



THE feature of the 1923 convention of the Chief Interchange Car Inspectors' and Car Foremen's Association of America, held October 3, 4 and 5 at the Hotel Sherman, Chicago, was unquestionably the interesting addresses delivered before well attended sessions. These addresses, together with the discussion which followed them, were not only interesting but inspiring as pointing out practical means by which members of the association can co-operate in overcoming wasteful practices and improving the efficiency of railroad operation. The first address was on "Lubrication," by M. J. O'Connor, special mechanical inspector, N. Y. C., T. A. Ward, district freight claim agent, N. Y. C., presented a paper on "Prevention of Loss and Damage to Freight," and there was a joint paper on "Maintenance of Equipment," by A. S. Sternberg, master car builder, Belt Ry. of Chicago, and F. C. Shultz, chief interchange inspector, Chicago. A. J. Mitchner, division general car foreman, Michigan Central, and W. J. Owen, chief interchange inspector, Pekin, Ill., read the papers on Car Inspection which won first and second prizes in the *Railway Mechanical Engineer* contest.

Election of Officers

On the last day of the convention the following new officers of the association were elected for 1924: President, W. T. Westall, special inspector, N. Y. C., Cleveland, Ohio; first vice-president, C. M. Hitch, district master car builder, B. & O. Cincinnati, Ohio; second vice-president, W. P. Elliott, general foreman, Terminal Railroad Association, East St. Louis, Ill., and secretary, A. S. Sternberg, master car builder, Belt Railway of Chicago.

Four new members were elected to the executive committee as follows: G. J. Charlton, general car foreman, O. S. N., Buffalo, N. Y.; E. G. Chenoweth, superintendent car department, C. R. I. & P., Chicago; J. G. Bannon, general car foreman, C. P., West Toronto, Ontario, and A. G. Richards, traveling car foreman, Chicago & Alton, Bloomington, Ill.

Since changes in the rules of interchange become effective January 1, 1924, the discussion of these changes will be pub-

lished complete in this issue, most of the addresses being printed later.

Discussion of Interchange Rules

With A. Armstrong, president of the association, in the chair the first question raised was regarding the scope of the discussion.

C. F. Straub (Reading, Pa.): I want to offer this motion, as a preface to our proceedings, in regard to discussion of the rules. The motion was made that all previous documents, opinions or discussions of committees reported to individual railroads by the secretary of the Mechanical Division, and not later incorporated in the rules as part of such rules for interpretation of same or reported as arbitration cases, shall be disregarded. Also, that all questions decided shall be by vote in open meeting to show the approval of this Association, and shall be reported by the secretary to the proper committee of the Mechanical Division, A. R. A., for action at the next annual meeting or otherwise, and such approval by this Association shall be recognized as just a proper practice until the decision in regular form has been announced by the Secretary of the Mechanical Division.

The motion was duly seconded and carried.

Rule 2

The Committee recommends that section (b), third paragraph, of this rule be modified to read in accordance with proposed form shown below
PROPOSED FORM—A leaky tank car shall have stenciled on both sides, in letters three inches in size, adjacent to the car number, the words "Leaky Tank. Do not load until repaired," and the owner shall be immediately notified. Stenciling must not be removed until the tank is repaired.
REASON—To improve the rule in the handling of such cars by requiring the stenciling to be shown on both sides of car.

F. W. Trapnell (Kansas City, Mo.): I understand that while we are using this pamphlet which was the proposed form from the Arbitration Committee to the A. R. A. Mechanical Division for adoption, they were adopted, and they will be practically our rules for the coming year, so I think we ought to leave out that matter of proposed, because that is what they will be.

T. S. Cheadle (R. F. & P.): I noticed on one or two

cars recently it was mighty hard to comply with the rules by stenciling adjacent to the number. There are cases where the conditions are such that it is a hard matter to get it adjacent. I suppose if you get it as nearly adjacent as possible it will be satisfactory.

Chairman Armstrong: I think it would be perfectly satisfactory, if you cannot stencil adjacent to the number, to get it as close to it as you can.

"The Committee recommends that a new paragraph be added to section (f) of this rule as follows:

For inside door protection, the car transfer check as shown on page 172, issued by the road having car in its possession, shall be authority for bill against road on which load originated, for cost of adjusting load due to absence of, or improper inside door protection, as well as cost of applying or correcting such protection. (See Section G. A. R. A. Car Service Rule 14.)

REASON—To conform to joint recommendation of Committee on Car Service of the Transportation Division, A. R. A. and Arbitration Committee, Mechanical Division, making originating road responsible for absence of or improper inside door protection. This recommendation has been approved by the General Committee of both Divisions and the necessary changes in Car Service Rule 14 were approved at the session of the Transportation Division at Chicago, April 25, 1923."

C. F. Straub (Reading, Pa.): Should we not, at this time, clarify that in some way, so there is a general understanding that this work can be charged for according to rules 101 and 107? I make that as a motion.

T. J. O'Donnell (Buffalo, N. Y.): Our officials had this matter under consideration in our Association. The executives are to act on this at a meeting in a few days; that is, the Executive Committee of our Association, and I wondered whether you have given any consideration to it. The prices that we charge (the twelve roads that I have the honor to work for) are \$11 a flat rate for the transfer and \$4 for the adjustment of lading, net. Inasmuch as this is in our A. R. A. rules, I am wondering if we should not recommend or at least have an understanding that the labor rates should govern, \$1.10 on all such work. The A. R. A. adopted this as a mechanical rule, and I really think there ought to be something from this Association so we will have some stable recommendation to give.

[After an extended argument as to whether this was a mechanical or transportation expense, action was taken as follows.—Editor.]

Chairman Armstrong: We are not getting anywhere, and I do not believe you men want to take up an hour or two discussing this matter. There is a motion before the house that we recommend a flat rate of \$3.75 for adjustment and \$11 flat for a transfer. This motion has been made and duly seconded.

A. S. Sternberg (Belt Ry. of Chicago): Eleven dollars for transfer does not enter into the motion; just the adjustment of the lading.

Chairman Armstrong: As many of you who will approve the rate of \$3.75 for adjustment of the load, as we have been talking about, for inside door protection, will manifest the same by saying "aye"; contrary, "no."

The motion was lost.

Mr. O'Donnell (Buffalo, N. Y.): I am going to ask if you will consider this motion: The chief interchange inspectors respectfully suggest that the subject matter be referred to the Transportation Division, with the recommendation that an equitable flat rate be adopted, which can be agreed upon by that body and will make the matter more conclusive and simple to handle.

The motion was seconded and carried.

Rule 3

The Committee recommends that section (o) be modified in accordance with proposed form shown below:

PROPOSED FORM—(o) Cars built after November 1, 1920, will not be accepted from owner unless equipped with 6 in. by 8 in. shank A. R. A. Standard Type "D" couplers.

REASON—To prevent the transfer of lading en route and to require car owner to comply with the rules.

A. C. Campbell (N. Y. C. & St. L.): In reference to this paragraph (o): Some railroads are practically rebuilding a great many cars; that is, putting more than 75 per cent

of new material in them and stenciling them as being newly rebuilt, and the reason of their doing that is that their center sills probably did not have the proper spread to take a 6-in. by 8-in. coupler, and they wanted to use up their old 5-in. by 7-in. couplers.

We are having trouble with some of these cars being refused from the owners under load, some of them with perishable freight and, under this section as adopted by the Association, they can't be accepted from the owner. They can be accepted in interchange from somebody else on the road, but they would not be accepted from the owner. Is it policy to turn down a loaded car with perishable freight just because they have a 5-in. by 7-in. coupler and they have a new car, whereas they will accept an old car, probably ten, fifteen or twenty years old with a 5-in. by 7-in. coupler that is not in good condition and go right along? I would like to know if the joint inspectors should issue a transfer card against that car and allow it to be transferred.

Chairman Armstrong: The Chair will answer your question as to transfer. There is no provision whatever.

Rule 17

The Committee recommends that a new section be added to this rule to be designated as section (i) and to read as follows:

The application of cast iron wheels cast after June 30, 1924, of nominal weight less than 650.700 and 750 lb., shall be considered as improper repairs.

REASON—To conform to recommendation from Committee on Wheels to prohibit the use of wheels lighter than the standard of the Association.

P. G. Zachretz (Soo Lines): I take it from that, that in making out our wheel repair card we will have to state both passenger car and freight car and the size of the wheels applied; that is, the weight of the wheels applied, in order to give the ruling line the proper information.

M. E. Fitzgerald (C. & E. I.): It isn't necessary for the owner to get joint evidence. The billing repair card will state that information.

The Committee recommends that interpretation No. 7 of this rule be modified in accordance with proposed form shown below:

PROPOSED FORM—(7) Q. No change.

A. The substitution of the Schaeffer patented brake lever connection does not constitute wrong repairs. If such connection is not standard to any of owner's cars, charge for same should not exceed cost of that of owner's standard.

Mr. Straub: I move the secretary be requested to obtain prices for those Schaeffer brake connections, arbitrary prices, so we will know where we stand on those parts.

Chairman Armstrong: I think that will be taken care of by the Price Committee; under the new rules, you will have that, so I do not think it is necessary.

REASON—It is felt that it is reasonable for car owner to accept charge for this device where used by owner even though not yet applied to the particular car in question.

Rule 98

The Committee will designate all paragraphs of this rule with letters for ready reference.

The Committee recommends that a paragraph be added to this rule reading as follows:

If new cast iron or new cast steel wheels are applied account delivering line defect on wheel or axle or both, owner may be charged for the difference in value between new and second-hand wheels, whether or not a defect card is involved. Similarly, if new A. R. A. standard axle is applied account delivering line defect on wheel or axle or both, owner may be charged for the difference in value between new and second-hand axle, whether or not defect card is involved.

REASON—Owner receives the betterment and would not be penalized in being billed for same. Also, it creates incentive to apply new material which is preferred by car owner and because it is in line with rule on wrought steel wheels.

Mr. O'Donnell (Buffalo, N. Y.): While it does not enter into the discussion, I think that is one of the best changes that has ever been put in the rules, especially where the fellow gets finicky and starts looking for cut journals. It means about three or four thousand dollars a month in our Association that the delivering line will save on that rule.

Rule 111

The Committee recommends that the following note be added to this rule in order to make it more clear:

NOTE—In cases where annual air brake cleaning is not performed, but triple valve is renewed account of defective body, charge may be made for material only. Also in such case if brake cylinder, brake cylinder piston or non-pressure head are renewed, account of defective, charge may be made for material and labor.

Mr. Jamison: This is the only item that we shall have on rule 111. I do not want to be out of order, but it would give me a great deal of satisfaction if this Association would ask the Price Committee to give us an interpretation in rule 111, or else an item covering the cleaning of what is known as loaded and empty brakes. It is twice the amount of work to clean the brakes on these cars as it is on the ordinary car, and yet we have nothing covering it; there is a variety of opinion and, consequently, a variety of different charges being made. I think if we were to ask that question now, and it were to be submitted to the Price Committee, as soon as possible after the close of this session they would perhaps incorporate it in the new rules.

The motion was duly seconded and carried.

Rule 112

Attention has been called to a misprint in Note 1 to this rule as shown near top of page 161 of the 1922 Code.

This note should read as follows and will be corrected in the first supplement to the rule issued.

NOTE 1—These rules are for the purpose of settlement between carriers

rules other than those quoted in Circular No. D. V. 283, which have just been read?

A. C. Campbell (N. Y. C. & St. L.): I would like to bring up the matter of transfer of cars. A great many loads are billed out from shipping points that are really reconsigned in transfer.

They may be reconsigned a half dozen different times before they go out on the line, especially potatoes and such things as that. These cars come in off the line, and they will be in bad order, which will necessitate transfer of that load which was to go forward. They reassign that load to the first road and then another, who is going to issue the transfer authority against the originating line that it comes from or against the line that reconsigns to another line? The rule allows that load to be reconsigned as many times as they want to on that bill.

Mr. Schultz: It has always been my personal opinion that if the load had arrived at its destination when it was intended; that is, as far as the delivering line should be re-



A. Armstrong
President



W. T. Westall
First Vice-President



C. M. Hitch
Second Vice-President



W. P. Elliott
Secretary and Treasurer

and between carriers and private lines, for destroyed or dismantled cars, handled under the rules of interchange, and are not intended to be applied to cars of the same particular types in the accounts of individual carriers.

The Committee recommends that a new paragraph be added as the third paragraph of this rule, reading as follows:

Second-hand trucks used under new car bodies or new trucks used under old car bodies shall be considered as of the same age as the car body in figuring depreciated value.

In addition to the foregoing changes recommended in the Rules of Interchange, the Committee will prepare appropriate revision of rules effected by the recommendations from the Committee on Wheels, if the recommendations of that Committee are approved by letter ballot of the members.

Respectfully submitted,

ARBITRATION COMMITTEE.

Mr. Straub: Inasmuch as the last paragraph refers to a recommendation by the committee on wheels, this question may not be out of order, although it may be covered by the Wheel Committee, the Price Committee or the Arbitration Committee, but nevertheless it is a condition which we sometimes run into. What allowance, if any, shall be made car owner by a company who has ground out slid, flat spots on cast iron wheels and replaced same in car, thus resulting in possible replacement of wheels at car owner's expense at an earlier date than otherwise? The practice is not recognized by the A. R. A., but occasionally performed by some railroad, and car owner should receive some protection.

Mr. Wells: Rule 98 fully covers that, and the car owner is fully protected. It is true the wheels would not have been removed only for the slid flat spots, but, at the same time, the owner is deriving the benefit of the new wheels, and I cannot see any reason why Rule 98 is not optional, because the difference in value will be charged between the defective and the new wheel.

Chairman Armstrong: Do you wish to take up any of the

sponsible for it. But in handling it through the traffic people, they decided the car had not arrived at its destination and was subject to reconsignment, where it was originally loaded and the transfer order should be issued against the originating line.

M. W. Halbert (St. Louis, Mo.): In St. Louis, we have the reconsignment rule. The roads are bringing the cars into the originating line in bad order, when they have not reached waybill destination. What I mean by that, if the car hit the line that is going to handle the car instead of reaching its regular destination it would receive a reconsigned order, and the party accepting the reconsigned order is responsible for the transfer; but if the car had not reached its waybill destination, the originating line is responsible.

To make it a little more clear, the car is billed to a line, and perhaps the billing will show a point on that line, but the car is received and reconsigned to another line. Now, is the road that reconsigned it responsible, or the party to whom we reconsigned the order?

Chairman Armstrong: Mr. Schultz answered the question as to the responsibility of the car being so handled, and I merely bring up the thought that the defects for which the car is transferred are old defects from the originating line and not new defects from the intermediate.

Mr. O'Donnell: When we have a number of cars in our district destined to the switching line, the industrial man on the switching line will reassign that car with lumber or other commodities, and we always make the road bringing in the car be responsible for the transfer to the second line that

transfers it, with the approval of the agent, so they understand it.

Chairman Armstrong: I think it is the general practice.

Rule 107

T. S. Cheadle (R. F. & P.): If I am in order, I would like to ask the question on rule 107. On page 148, item 417 A, it says:

Underframe, steel (repair type) or continuous metal center sills to which are secured metal body bolsters or metal or wood cross ties, first application or R. & R., includes R. & R. of underframe or continuous metal or continuous metal center sills for removal or repairs to top gusset plates over cross ties, center girders, bolster stiffeners, or other parts of underframe (excludes R. & R. or R. of flooring) (add jacking of car when necessary) 27.0 hours on ordinary car; 37.0 hours on refrigerator car.

This price, as I understand it, covers the R. & R. and the steel underframe to make repairs to the portion mentioned. There have been a number of cases on my line where it was necessary that a steel underframe of this class be put at one end of the car to make certain repairs. I want to ask what, in the opinion of the members who investigated these, should be the charge. Should it be a reduction of one-half, or should it be on a bolt, nut and lock basis, or what charge can be made?

Chairman Armstrong: Will some gentleman answer Mr. Cheadle's question?

M. E. Fitzgerald (C. & E. I.): I think you are entitled to full charge. However, if you saw fit to reduce that charge, I do not believe anyone would kick any in receiving it. I do not think it would exceed the total labor charge, but if you see a manner in which you can expedite the work on your line, you do not need to go into full details of performing the operation.

Loading Rules

Mr. O'Donnell: We have three or four important changes in the loading rules, one in particular that I think Mr. Rogers, of Youngstown, has brought out, proposed revision of Rule 28. This is the proposed form:

Bearing pieces must never be placed between bolster and end of car, unless special provision is made therefor and detailed instructions given. When there is but one bearing piece on the car, it must be placed at least twelve inches from center of bolster toward center of car.

This is the addition:

Sliding pieces should preferably be placed over the car body bolster, but in case of flexible material, in order to obtain the required four inch clearance from floor of car, the sliding piece may be placed not more than eighteen inches ahead of center line of bolster on cars of steel or steel underframe construction.

The Loading Rules Committee has put in this recommendation generally for new cars:

All drop end gondola cars to be equipped for the reason they are replaced, etc.

What I want to bring out is that we are losing a lot of \$12 or \$15 end gates, due to the fact that when they unload the commodities at the steel plant, they find that in some other part of the car. I think it is an injustice to the owner to lose the end of a good 50-ton car in the way they are being lost, and this appealed to me. Of course, the Loading Rules Committee recognized that fact, but it is deplorable the number of end gates that come home to the owner in that condition.

Mr. Fitzgerald: I would like to get an expression from the chief interchange inspectors as to whether or not, in case of twin or triple shipment of piling, in moving through an interchange, it is found that one of the brake staffs is entirely missing. The rules, of course, provide that you only need one brake shaft in twin or triple movement, and in loading the car they take the brake shaft off and are supposed to fasten it to the car. But assume now this equipment is missing (the brake shaft), is it a cardable defect?

W. R. Rogers (Youngstown, Ohio): I would say if you have removed the brake shaft to facilitate the accommodation of the load, it surely is a cardable defect, in accordance with A. R. A. rule 32.

Mr. Fitzgerald: I do not agree with the gentleman. I would like to get an expression from the chief interchange inspectors as to whether they think it should be cardable in interchange. I am now speaking of the fellow who loads the car, wired it securely to the car, but in transit it has become lost.

Mr. Campbell: In the Twin Cities, we do not card for them unless we know it is a known theft of the brake shaft, because that brake shaft may be somewhere in that load, and I do not see why we should apply for it. We do not in St. Paul.

A. Herbst (N. Y. C.): The rule covers very plainly material missing, removing or cutting out parts of car to facilitate loading or unloading. If you are going to card for missing brake shaft, you have to card for missing door protection.

Chairman Armstrong: Are there any other questions on the loading rules?

S. M. Anderson (No. Pac.): I would like to ask the billing men of the association their understanding of the word "correction," paragraph "C" of rule 92? If the bill is returned having charges in excess of 10 per cent, you may return it, but I would like to know if the bill has to be corrected what the authority will do. It is my understanding that the bill must be corrected in accordance with the rules, but so many of them return them and claim that the authority is sufficient.

Mr. Pyle (So. Pac. of Mex.): We handle a good many cases of this kind. I think it is right under the rules we have. I know we have to return the bill if the amount is more than 10 per cent and insist on the bills being corrected, although I do not handle anybody's bill that way. If I return his bill and it amounts to more than 10 per cent, and he sends me a counter billing authority, I am perfectly satisfied with it.

Livingston Martin (B. & O.): I agree with Mr. Pyle. The A. R. A. recognizes the counter billing authority. At the same time, I believe, technically under this rule, you could force the correction of the bill. But I want to say you are getting awfully technical if a man sends you a counter blank authority and you send a bill back and insist that it be corrected.

Mr. O'Donnell: In loading brick in rough freight cars, would it be permissible, if we find the doorway in distress, to charge the originating road with the cost of putting in the commodity or placing it back so it would not reach the door?

Mr. Schultz: The principal part of the rules regarding how bricks are to be loaded, is based on a 60,000-lb. capacity car. If you try to load 100,000 lb. of brick they won't stay in the car. In case the load exceeds the stated amount and bricks came in contact with the door, is door protection required?

Mr. O'Donnell: I penalize the delivering line when the door is in distress. I feel our association, or the A. R. A. rules permit charging for any such work, irrespective of the prints that Mr. Schultz refers to, but we always report it back to the fellow who loads it to use more caution in loading.

Other Business — New Members

B. F. Jamison (Southern): We are a committee to go out and get new members. I have not done, this year, quite as much as I did last year. I think brother Elliott expected more of me, but circumstances prevented me in some way from doing that. Now those circumstances are changed, and I am going to try to do some real good work on getting members for this association.

The dues are \$3.00 a year, no application or initiation fee, and the member receives the *Railway Mechanical Engineer*, to my mind the best publication he could get, for 12 months

and a printed copy of the proceedings. During the year, I have heard such expressions as this, "One paper in those proceedings is worth 10 times the membership," and it is. Gentlemen, one copy of the *Railway Mechanical Engineer*, properly used, is worth it, and yet you are going to get 12 copies.

You have a splendid argument. You are not taking away anything from any man when you ask him to join the Chief Interchange Car Inspectors' and Car Foremen's Association and pay \$3.00 for his membership; you are giving him something and giving it to him richly.

Chairman Westall: You have heard the remarks made by Mr. Jamison, and I hope all of you feel the way he does, and when you return home that you will not wait until next year to get these members to come into the association, but as soon as you return, go after them and see if we cannot increase our membership next year to ONE THOUSAND.

Lubrication

By M. J. O'Connor

Special Mechanical Inspector, New York Central

Some of the chief interchange inspectors and car foremen on the various railroads have well said that lubrication is a very broad question. For example, the heating of journals is invariably charged to lubrication, whereas we know that the following conditions, which lubrication will not overcome, are conducive to the heating of journals:

(1) Slid flat wheels and shelled wheels, which are caused by air brake conditions.

(2) Broken oil boxes and tipped oil boxes—the latter condition being caused by worn pedestals and oil boxes on passenger equipment cars.

(3) Broken truck springs and weak truck springs under freight cars are also conducive to the heating of journals, as under these conditions we do not have side bearing clearance on the side of the truck.

(4) Excessive slack in draft gear, particularly under freight cars increase service shocks, while cars are enroute in trains, thereby disturbing the conditions in the contained parts of journal boxes under such cars.

Waste Grabs—During the past year, the question has been asked, What is a waste grab?

A waste grab consists of one or more strands of waste that separate from the body of the packing in the journal box, and when this occurs, the waste will, under ordinary service conditions, become wedged between the journal and journal bearing.

The service conditions that contribute in developing a so-called waste grab consist of shocks at high and low rail joints, heavy application of air brakes and fast speed over railroad crossings, these being causes over which we have not positive control. However, during the past few years the following methods have been adopted with a view to keeping down this apparent cause of journal heating.

Journal box packing is applied in one mass, allowing the strands to hang down outside the mouth of the journal box, always adding more packing before placing the hanging strands inside the journal box flush with the inside face of the collar of the journal. This has greatly reduced waste grabs.

The lining of journal bearings also enters into developing so-called wipers or waste grabs, particularly so where the lining is recessed more than 1/32 in. on the side, and, for this reason, only within the past year, we insisted on our bearings being lined along these lines.

The continuation in service of mongrel types of wedges, including the solid back when worn flat, contributes in developing waste grabs, for the reason that such wedges will not allow the bearing to slide laterally with the journal when

worn down, so that the full bearing surface of the brass rests on the journal, resulting in excess friction, and where loose strands of waste happen to be on the surface of the packing, most anything may happen under these conditions.

Journal Bearings—During the past year, a power boring machine for use in broaching journal bearings was installed on a coal producing division, where approximately 1,000 cars of coal are loaded per day, and since the installation of this machine, the journal failures, particularly under cars re-wheeled or re-brassed, have been reduced more than 75 per cent.

Journal bearings having end wear more than 1/16 in. on either the collar or fillet end should not be relined. Also journal bearings which show indications of wedge wear on the backs or sides, even though it be but 1/64 in., should not be relined.

Furthermore, journal bearings that are found in condition for re-lining should have the old bearing surface bored, for the reason that the surface, after the lining is removed, is more or less oxidized, and the re-boring is absolutely necessary in order that the tin will properly cling to the surface.

At the present time, the average thickness of the brass back on journal bearings is approximately 7/8 in. minus the babbit lining. Therefore, it can readily be seen that to obtain a good clean surface in the re-lining of old brasses, it is found necessary to reduce this thickness from 1/32 in. to 1/16 in., and this, in my opinion, further weakens the brass back.

More than a year ago, some passenger equipment cars operating in very fast trains, were equipped with 9 in. bearings, the backs of which were 1 in. in thickness. A close observation was kept of these cars, with the result that after these bearings had been in service one year, making approximately 120,000 miles, they showed little, if any, end wear, and the lining wear was hardly noticeable. Therefore, I believe that increasing the thickness of these bearings 7/8 in. (the thickness being added to the back and sides) is a step in the right direction, as we have found that the present standard journal bearing wedge properly fits this so-called thick back brass.

I would also recommend that the panelling on the backs of journal bearings, which consists principally of the name of the railroad, pattern number and size, be discontinued, these markings to be placed on the sides of bearings, as the present method of marking these bearings on the brass back further reduces the strength of such bearings. It has been found that the stamping of these marks does not, in all cases, produce as good a bearing surface as the bearing with the plain back.

All passenger equipment cars should have truck sides stencilled, showing the station, month, date and year when the boxes were last jacked, bearings examined and boxes repacked, as it has been found, where this practice is in vogue, it affords the railroads who maintain men exclusively to cover this particular feature of the work, an opportunity to know whether or not the journal box and contained parts under such cars are in serviceable condition.

The jacking of journal boxes and examination of bearings should be done at least once every six months, particularly on cars not making a shop movement, this work to be performed where terminal facilities will permit.

Journal Bearing Wedges—Too much importance cannot be attached to the journal box wedges. For example, a few years ago, our railroad was averaging 27 per cent defective journal bearings removed from journal boxes during a certain period, and of this total, more than 60 per cent were removed on account of cracked linings, whereas, during the first six months of this year, notwithstanding that we have about doubled the number of boxes jacked up, the defective bearings have been reduced to 17 per cent and the cracked linings to 31 per cent. Therefore, these improved conditions simply

mean more service wear from the journal bearings and less heating of journals.

Use of Material—Great care should be exercised in the handling of the oil used in the lubrication of car journals, for the reason that the oil company who manufactures this material tells us that the oil used during the summer season is heavy, while the oil used during the cold weather season is of a lighter quality.

Our past experience has fully demonstrated that requisitions for summer car oil should be made March 1, for use in April and succeeding months until September; requisitions for winter car oil should be made August 1, for use in September and succeeding months until April. Winter oils remaining on hand April 1 should be used with summer oil in the proportion of half and half until disposed of.

When consignments of oil are received, that on hand should be placed so it will be used before shipments received later. This obviates the carrying of oils into the season for which they are not intended, and care must also be taken in order to avoid having a surplus of unseasonable oil on hand at the change of seasons.

Cleaning of Oil Tanks—Oil storage tanks must be cleaned every year, and this is best done when changing from one season's oil to another.

In conclusion, I would say that all of the features in connection with lubrication and the care of journal boxes, as outlined, can be obtained only by eternal vigilance and hearty co-operation on the part of the car department forces.

Discussion

Chairman Armstrong: Will you kindly explain or give us some idea of what this boring machine is? I infer, from the paper, that boring is done prior to the relining. This work is done, as I understand it, on old brasses prior to relining. What is the nature of the machine?

Mr. O'Connor: It just bores out the old surface in order to obtain a clean surface.

Chairman Armstrong: That does away with the old and much used method of throwing them into the fire and burning it out.

Mr. O'Connor: Absolutely.

G. P. Zachretz (Soo Lines): The Soo Lines have machines at all of our important stations, where we use them for boring out or broaching out the new brasses to get a perfect bearing; also all good second-hand brasses we put through this machine and bring them back to a proper size for bearings to fit the journal, that is, the A. R. A. sizes. We find that by using this machine, we can bring back a great many second-hand brasses and put them back in stock. That is more particularly true of passenger brasses. When we change wheels under a passenger car, we take those brasses and, instead of trying to fit them, as I have seen people do, we put them through this machine and use them back as new stock.

I would like to ask the gentleman who read the paper if he has found, by actual experience, that the lettering, stenciling on the back of the brass has actually reduced the strength of that brass so that it would noticeably cause cracked brasses?

Mr. O'Connor: Yes, positively. In other words, when those so-called panelings or markings are put on the backs of bearings, they are counter sunk, aren't they? That weakens the brass.

A. Berg (Erie): I would like to ask Mr. Zachretz if, when broaching second-hand bearings, he experienced any trouble of the lining breaking on account of having become hardened while they wear; if in that process he loses any number of bearings?

Mr. Zachretz: I will say, in answer to Mr. Berg, that we have not experienced any such trouble. As a matter of fact, we have taken brasses from passenger service, broached them out and put them back in passenger service with very

good results. In our St. Paul yards, we have kept the record of a number of cases where we have treated brasses in this manner, and we have found the brasses would wear out the second pair of wheels and yet be good brasses.

Of course, when we machine that brass out, we lose a certain amount of the babbitt metal, and then when we put that on, to another journal and wear another pair of wheels out with it, we are a little leary about machining it a second time and putting it back in passenger service, but we have put such brasses back in freight service and we have not noticed any bad results.

Mr. Spangler (Frisco): I would like to ask Mr. O'Connor if he is broaching second-hand journal bearings and applying them to foreign equipment?

Mr. O'Connor: Positively not.

Mr. Spangler: Has the committee ruled it would be proper to bill the car owner for the broached car bearing?

Mr. O'Connor: Not that I know of.

Mr. Herbster: I just heard a gentleman say he would not think of broaching out a second-hand bearing and put it back on passenger service, but he would on freight service. Now, I do not doubt but he realizes that freight cars run as fast as passenger cars in this country, at least on a good many railroads, and I believe the railroads are going too far in the reclaiming of journal bearings. You cannot take a bad thing and put it back in another thing without causing trouble to somebody else. You may not notice it yourself, but the other fellow does and the fellow who runs the fast trains has trouble with that and a good many more things.

Now, in regard to jacking up freight cars: The company which I represent has done that for sometime on its own cars and had to finally come to it on foreign cars on the fast trains. It is surprising the number of worn, cracked and pitted bearings that we are obliged to remove in order to get the trains over the road in the short schedule they give us.

We take any train that comes into any of our yards from any connection, in fact, from our own rails, and go over it and jack up any number of cars and remove sometimes only one, sometimes none, and, in some cases, eight journal bearings, and perhaps then find a pair of wheels with a seamy journal or an unevenly worn journal. We are trying to do everything possible, in order to get the car over the road, and I would like to see this association go on record as discouraging the reclaiming of second hand bearings.

A. J. Charlton (O. S. N.): I heard Mr. O'Connor read his paper, and there were several things which I think we ought to take exceptions to. First, as I understand, the machine he talks about, using the old brass for the purpose of getting the clean surface to revamp it; the second is to broach the brass to get a crown bearing on the finished brass.

I happened to be in a locality where the company makes it a rule to broach all brasses used, and I think our friend, Mr. O'Connor will substantiate what I say, they have more trouble than the road I represent, which does no broaching whatever.

Mr. Graham (Galena-Signal Oil Company): Some member said that in the spring and in the fall, on account of changing the oil, was the time they had the hot boxes. I think Mr. O'Connor will bear me out in saying that, on the New York Central Lines, since they started to jack up the boxes and examine the wedges and brasses, etc., on their passenger equipment, they have not had any epidemic in the fall or spring, but previous to that they always had epidemics.

If the mechanical defects are kept down, you are not going to have very much trouble with hot boxes on either freight or passenger cars, in my opinion.

D. P. Crillman (M. C.): We very frequently find cars equipped with steel wheels, and one of the wheels turned down practically to the limit. What effect would that have in hot boxes when we have a tipped truck?

Mr. O'Connor: That would be conducive to journal heat-

ing, for the reason you would throw the weight on the low wheel. Particularly while the car is enroute on trains. The body bolster would be tipped and the truck would not curve properly. I was glad to hear that brought up.

I talked with a man a month ago on that same condition. On a four-wheel truck, the inside pair were of perfect thickness and the other were of the minimum thickness, and that is surely conducive to hot boxes.

Chairman Armstrong: As has been stated, eternal vigilance is, in my opinion and from the consensus of the discussion, the only thing which will tend to eliminate or reduce hot boxes. We have heard this splendid paper and this discussion. Let us go home and profit by it, let us not forget what we have heard.

Recent Decision of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Time Limit for Making Repairs

On September 25, 1916, the New York Central issued a defect card covering five metal side stakes bent, one metal end sill bent and one push pole pocket broken, on Bessemer & Lake Erie car 35366. It was reported that this damage was due to unfair usage. On April 28, 1921, the Bessemer made the repairs covered by the defect card and rendered a bill against the New York Central. The New York Central objected to the charge on the grounds that the repairs had been made two years from the date of the first receipt of the car on the home lines. It claimed that the charge should be cancelled. The Bessemer & Lake Erie refused correction, contending that in the case of this car the present two-year restriction upon defect card did not apply to this card as it was issued prior to the establishment of the two-year restriction. It further contended that in this case Rule 5 should not govern as its application would be retroactive and therefore illegal.

The Arbitration Committee decided that the time limit for making repairs, specified in Rules 5 and 94, as well as the time limit for rendering of bills, as specified in Rule 91, became effective at the time these requirements were incorporated in the rules and that they cover all cases regardless of the date of the defect card, billing repair card or joint evidence card. The rules in effect at the date of defect cards for billing repair cards are effective only in so far as prices, responsibility, etc., are concerned.—*Case No. 1273. New York Central vs. Bessemer & Lake Erie.*

Final Cost of Repairs Exceeds Rule 120 Allowance

The Detroit & Toledo Shore Line car No. 249 was forwarded by the New York, New Haven & Hartford to its Oak Point repair yards on November 14, 1920, for repairs, claiming that it was in a decayed condition. Inspection by the New Haven at Oak Point indicated that the car could be repaired within the labor allowed under Rule 120. The New Haven claimed that as the work progressed, hidden defects developed, which brought the labor charges above the allowance under the rules, up to \$108. The ultimate charges amounted to \$126.48, a bill for which amount was submitted to the Detroit & Toledo Shore Line for payment. This bill

was rejected on the grounds that the car had not been reported under Rule 120. Counterbilling authority was, therefore, issued by the New Haven for \$55.44, of which \$18.48 was applied for labor and \$36.96 for material, to bring the amount of labor within the limit prescribed by Rule 120. The Detroit & Toledo Shore Line still declined to pass the bill as rendered, even with the offset authority, claiming that from the nature of the repairs, it was indicated that the car had received rough usage as outlined in Rule 32. It took the position that the footnote of Rule 43 was designed as a protective measure to car owners against the abuse of equipment while in the possession of the handling road, and further that in the functioning of Rule 120, the car owner must, as a basis for decision and in recognition of the protection and equity sought by the rules, be furnished with at least some conclusive evidence to enable a fair, equitable settlement between the parties to the controversy.

The decision of the Arbitration Committee was that "the principal repairs consisted of two center sills spliced at both ends; four center sill fillers renewed; two end sills renewed; two draft timbers renewed, 32 pieces of flooring renewed. The owner's contention of unfair usage is not sustained. The case should be settled on basis of Arbitration Decision No. 1,053."—*Case No. 1,271, New York, New Haven & Hartford vs. Detroit & Toledo Shore Line.*

Where Wrong Repairs Are Claimed Joint Evidence Is Necessary

Wheeling & Lake Erie car No. 29,110 was repaired at the Trenton, Mo., shops of the Chicago, Rock Island & Pacific on June 2, 1920. The billing repair card showed that one Westinghouse H-2 triple valve had been applied to the car. The Wheeling & Lake Erie did not procure a joint evidence card when the car first arrived on its line. However, a billing repair card from the New York Central, dated July 30, 1921, showed that it had applied one K-2 triple valve to the car and an H-2 triple valve, stenciled T. R. 60, R. I., had been removed. This, it was claimed, also showed that the car was stenciled for a K-2 triple valve. The Rock Island refused to issue a defect card to the Wheeling & Lake Erie covering wrong repairs, on account of the absence of a joint evidence card. It also claimed that the New York Central billing repair card could not be considered valid as it was not the billing repair card of an intermediate line. The owners brought to the attention of the Arbitration Committee that it had rendered a decision on November 10, 1921, reading as follows: "If a repairing line knows that it made wrong repairs, it should promptly issue a defect card without requiring joint evidence; defect card should be attached to the car at the time wrong repairs were made." The Rock Island stated that its records in this case were destroyed when the shops at which the repairs had been made were burned. Therefore, it neither denied nor accepted the responsibility at any time, but held that the Wheeling & Lake Erie had no right to present the claim, as it had no admissible evidence to show that the Rock Island was responsible. It contended that the Wheeling & Lake Erie's claim must be denied or else the definite provisions of Rules 12 and 90 should be stricken from the Interchange Code.

It was the decision of the Arbitration Committee that a "wrong triple valve is an item that should have been readily discovered when the car was on the home line, and therefore the New York Central billing repair card cannot be considered under Rule 90 for the reason stated in Arbitration Case No. 1,167. In any such case, however, if the repairing line is convinced that it made wrong repairs, it should not hesitate to use defect card in accordance with the spirit of Rule 87."—*Case No. 1,270, Wheeling & Lake Erie vs. Chicago, Rock Island & Pacific.*

Efficient Tools Used At Milwaukee Car Shops

Description of Several Tools and Devices of Proved Value in Speeding Up Car Shop Work

By C. Petran

General Machine Shop Foreman, Chicago, Milwaukee & St. Paul, Milwaukee, Wis.

A SHOP with up-to-date machinery but not provided with special tools for this machinery will be a dismal failure both in efficiency and productiveness. To get maximum output car shop machinery should always be provided with the best of high speed steels for all wheel borers, axle lathes, coach wheel turning lathes, engine lathes, planers and shapers. High speed drills are essential for drill presses and the best carbon steel for threading dies in bolt cutters.



Fig. 1—Lever-Operated Drill Press Can Be Taken to the Job

The following descriptions pertain to special tools and what they have accomplished in production at the Milwaukee shops of the Chicago, Milwaukee & St. Paul.

Portable Hand Lever Press Drill. This tool (Fig. 1), made from a Liberty air motor stand, is merely an improvement on what a machinist would call an "old man." The feed was formerly operated by air but this arrangement proved a failure. As a result the idea was conceived of making a lever-operated drill press. The air feed was replaced by lever attachments with an air motor, capable of drilling up to 13/16 in. holes. The illustration shows the machine as used on the repair tracks and in the coach shop. Here it is taken to the job, instead of the job to the drill press. This type of drill is also provided on benches and posts in different departments.

Rivet Busters. Since receiving the blue print of the original buster we have put on an improved valve, a safety first spring to hold the chisel in place, and removed 21 parts. Originally each buster had over 50 parts to it. Now it has less than 30. These rivet busters reach further under a car and are half the weight of most machines. They also strike a harder blow.

Air Jacks. This jack (Fig. 2) is indispensable on a track that has many cars to jack up. By placing this jack under the draw-bar any light car can be jacked up in a few minutes

with two men, thereby eliminating two men and saving half the time.

Double Grinding Wheel Stand. If a casting or forging requires a little to be taken off the end or side, filing and chipping is a long job but with a grinding wheel near at hand the casting can be fitted in a short time. A double-wheel, belt-driven grinder has been developed at Milwaukee for use close to the work and will save much time formerly spent walking to and from the shop grinder or performing the fitting operation with a chisel or file.

Home-Made Sanding Machine. This machine (Fig. 3) is used in the cabinet shop of the wood mill and cost not over \$30.00 to make. It has wooden spindles 1½ in. to 7 in. in diameter to fit any radius, also three double face discs 18 in.

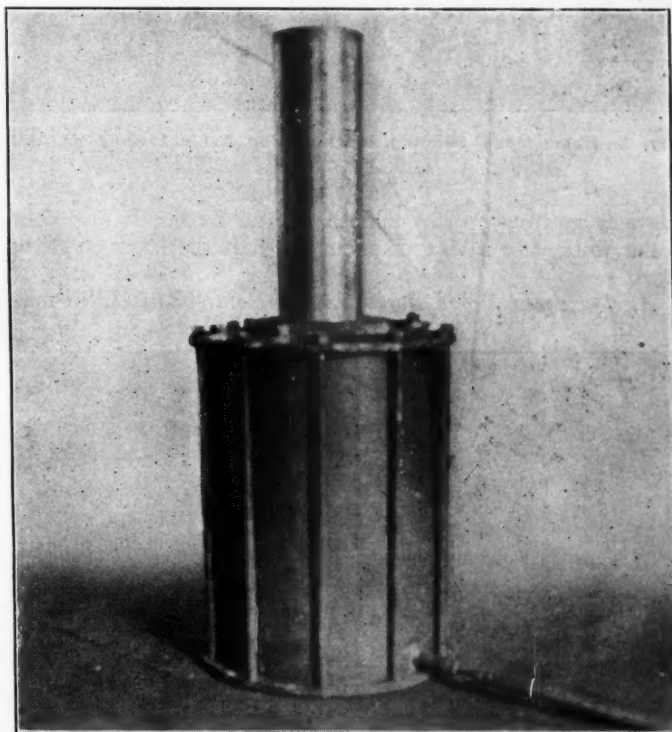


Fig. 2—Pneumatic Jack Which Saves Time in Lifting Cars

in diameter. The following table indicates what can be done on this machine and what savings can be expected over hand labor:

Articles	Hand labor each	Machine labor each	Saving each
Berth number plates.....	\$.31	\$.05½	\$.25½
Drinking cup holders.....	.19½	.05½	.14
U Connector blocks.....	.09½	.01¾	.07½
Hopper seats, Mail and Pass.....	.70	.23	.47
Coach seat ends.....	.35	.14	.21
Sleeping car step ladders.....	.35	.17½	.17½
Ceiling bands.....	.23	.11½	.11½
Electric light fixture bases.....	.17½	.05½	.12

Combination Rip and Cut Off Saw. A machine of this type is used to cut various kinds of parquet work, saving about one-half of the material on account of using very fine

*Abstract of a paper read by Mr. Petran before the Chicago, Milwaukee & St. Paul car department staff meeting at Milwaukee, Wis. Pictures of the various tools were thrown on a screen for the benefit of the assembled car foremen.

saws which are also home-made. There is also considerable saving made on this machine in connection with manufacturing mitre work on various notice frames and folding screens for passenger car equipment which eliminates push-



Fig. 3—Home-Made Sanding Machine for Cabinet Shop or Mill Room

ing a large iron-top saw table back and forth. It also does better work, at a saving of about one-half the labor on mitre work.

Angle-Corner Wood-Boring Attachment. This little ma-



Fig. 4—Close Quarters Boring Attachment for Air Motor

chine (Fig. 4) is indispensable for boring wooden center sills. We can bore holes in center sills within an 8 in.

space and within $1\frac{3}{4}$ in. of the flooring. This machine is fool-proof, as not a gear or set screw is exposed on any part of the machine. The machine has an 18-in. shaft extending from it which is attached to a No. 61 Thor wood-boring air motor.

Reclaimed Axle Centering Machine. This machine (Fig. 5) was built to drill and center all reclaimed axles. It consists of a 14-in. channel taken out of the scrap pile with two pair of wrought iron legs arranged to support it. Two

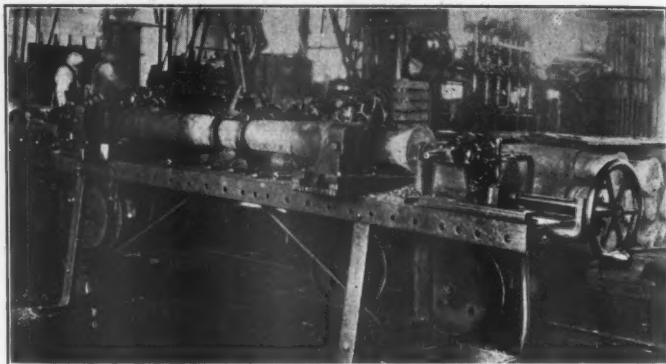


Fig. 5—Centering a Reclaimed Car Axle

sets of jaws are provided, operated by right- and left-hand screws to chuck the axle central at the sand collar. A movable table at each end with two small air motors attached operates the drills for centering. A guide bushing set central with the jaws insures accuracy.

This machine saves the company about \$35.00 a day. With the old style of centering with a template and drilling, 15 axles a day could be centered with two men on the job. With the new machine as described, 75 axles are centered a day with two men on the job.

Circular Saw. A circular saw, run by an air grinder motor and equipped with a sliding table, has been erected primarily for cutting Blox-on-end flooring to the sizes needed for laying it. This cutting was formerly done by hand. The estimated saving per express car in which Blox-on-end floor

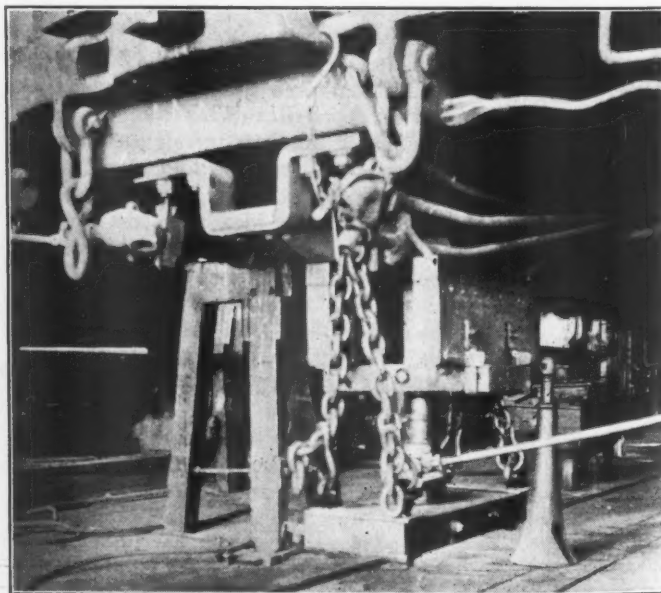


Fig. 6—Convenient and Effective Device for Removing Stuck Draft Gears

is laid is 22 man-hours at 70 cents an hour or \$15.40 a car.

Draft Gear Extractors. A draft gear extractor (Fig. 6 and 7) is designed to remove the draft gears on passenger cars

having cast steel draw lugs. On many of these cars the draft gears are wedged in so that it requires from 12 to 16 man-hours to remove one. By using the extracting device illustrated a draft gear can be removed in two man-hours at a saving of \$7.00 to \$9.80.

The principle of the extractor is evident, as a heavily-

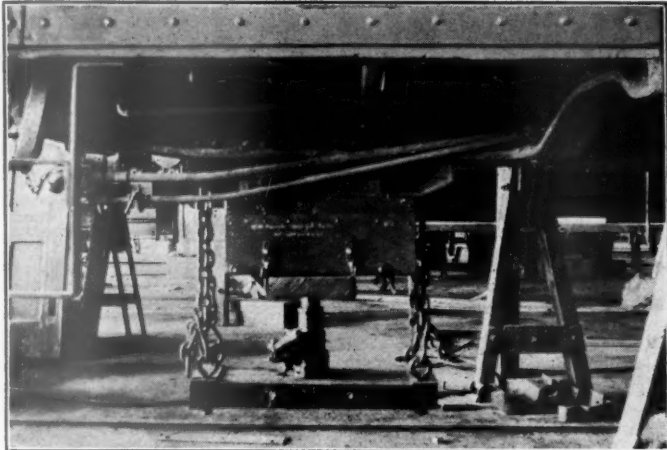


Fig. 7—Another View of the Draft Gear Remover

braced wooden framework straddles the draft gear and resists vertical movement of the jack ram reacting powerfully to push down the bottom block whenever the jack is operated. This tends to pull down the draft gear by means of the chains shown.

In conclusion I wish to state we have many home-made machines in the blacksmith shop, air brake shop and other departments that are showing a handsome saving per year, and that is why with the decrease in forces an increase in production is continually going on. Oftentimes our superiors wonder why we are producing more with a smaller force, but it is all due to special tools which decrease the man power required and increase production.

Form for Ordering Arch Bars

By F. C. Watrous
Division Car Foreman, Erie

The illustration shows a form for ordering arch bars that has been used very successfully on the Kent division of the Erie. For some time considerable difficulty had been experienced in educating the car inspectors at outlying stations to a point where they were competent to order an arch bar for any car set out. Some inspectors, who perhaps were better educated than their fellows, were successful, while others experienced a lot of trouble. On innumerable occasions it was necessary to send a second set of arch bars to get the car moving.

Cars that are set out at outlying stations between terminals are often left on the station or team track until repaired. The use of these tracks is essential to the economical operation of any station, and when one of these tracks is blocked with a crippled car that cannot safely be moved, it is of importance that the car be repaired with the least possible delay. To accomplish this, the form was developed, and up to the present time it has met all requirements. These forms are furnished to all inspectors at outlying points, and are promptly filled out when a car is set out at their station, or in their territory, with a broken or cracked arch bar. After the form has been made out, all measurements are carefully checked to avoid mistakes. The car inspector then telephones the nearest

terminal and the clerk fills in one of these forms as directed by the car inspector. This form is then turned over to the stores department, which arranges to have the arch bar manufactured and shipped on the first passenger train. In this manner, cars set out at outlying points on account of defective arch bars are repaired without delay.

In the majority of cases, cars are repaired within 16 hours after being set out. This is all the more remarkable when it is considered that a majority of the cars set out of trains on

ERIE RAILROAD COMPANY

Car Foremen & Inspectors: _____ Jurisdiction of Kent Shop.

When in need of arch bars or bottom straps, order same by wire to avoid delay. On empty cars or cars of unimportant freight, order by train, mail. In either case specify sizes and dimensions on diagram below, and be sure that your measurements are absolutely correct.

Station _____ Date _____ Time _____ Inspector _____

A - Drop of bottom arch bar _____
 AT - Raise of top arch bar _____
 STB - Drop of bottom arch bar strap _____
 B - Distance from center to center of box bolts _____
 C - " " " " column bolts _____
 D - " " " " of box bolts to center of column bolt _____

NOTE: When double column bolts dimension "D" to be from outside column bolt to 1st oil box bolt.

E - Distance from corner to corner of arch bar inside _____
 HB - Size of box bolt holes _____
 EC - " " column bolt holes _____
 SBA - " " iron in bottom arch bar _____
 SEA - " " " " top arch bar _____
 STB - " " " " bottom strap _____
 F - If bolts are required give size and length _____
 G - Car No. _____ Initial _____ Capacity _____ Kind _____
 H - Help required to repair (Yes _____ No _____)
 J - Jacks required to repair (Yes _____ No _____) No. _____ Capacity _____

Kent - Date _____ Div. Car Foreman _____

Form Used on the Erie for Ordering Arch Bars

account of defective arch bars are set out at stations remote from supervision and where one car repairer handles the cars set out at two or three points within a radius of 10 miles from his home station.



Interior of Pullman Buffet Car on London, Harrogate and Newcastle Train of the London and North Eastern



Motor-Driven Passenger-Baggage Car and Trailer Built by the Four-Wheel Drive Auto Company

Two-Car Motor Train for Mississippi Central

Chassis, of Four-Wheel Drive Type, and Trailer Provide Baggage Space and Seats for 46 Passengers

THE two-car, motor-driven train illustrated was recently built by the Four Wheel Drive Auto Company, Clintonville, Wis., for service on the Mississippi Central. It will operate from Hattiesburg to Beaumont, Miss., a distance of 27 miles with a ruling grade of 1 per cent and a maximum curvature of six degrees. The motor unit provides space for baggage and seats for 12 passengers. It weighs, complete, 11,000 lb. and has a wheelbase length of 185 in. The trailer chassis seats 34 passengers, weighs complete 6,300 lb. and also has a wheelbase length of 185 in. The lengths of the motor unit and trailer, center to center of the couplers, respectively, are 25 ft. 5½ in. and 27 ft. 5 in.

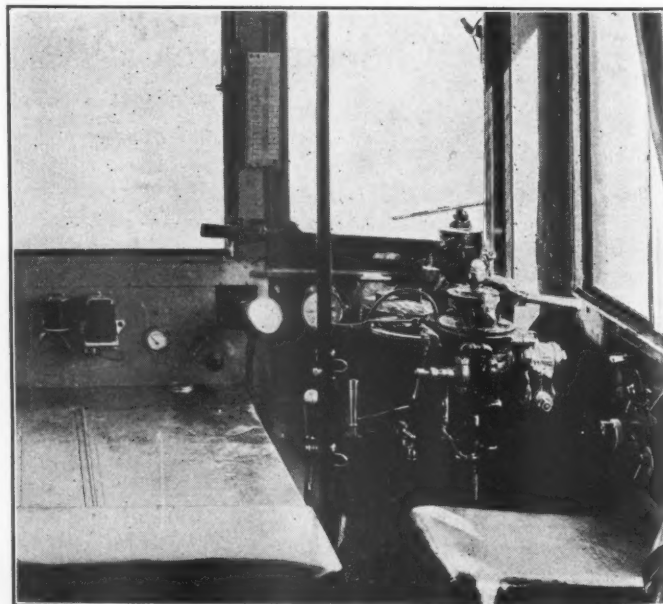
The motor chassis is provided with a six-cylinder 62-hp. motor having a bore of 5.1 in. and a stroke of 5.5 in. with a piston displacement of 672 in. While the S. A. E. rating of this motor is 62 hp. it develops 94 hp. under brake test. Force feed lubrication is provided. The cooling system capacity is 15 gal., the water being circulated by the centrifugal pump and cooled in a tubular radiator supported by a 3-point suspension.

Ignition is provided by an Eisemann high tension magneto with impulse starter. The carburetor is of the Stromberg plain tube type. The gasoline system has a capacity of 30 gal. with the tank mounted at the side of the chassis. The gasoline is fed by air pressure, applied through a reducer valve from the air brake system.

The clutch is of the Hele Shaw multiple disc type with a clutch brake. The jaw clutch transmission operates with the gears always in mesh, providing four speeds forward and four speeds in reverse. The reverse gear mechanism is mounted in the sub-transmission. This reverse mechanism contains a differential and permits the power to be transmitted to the car in either forward or backward direction. The mechanism is controlled by a hand lever near the driver

similar to the reverse lever of a locomotive and is mounted on ball bearings throughout. It is housed in an oil-tight, dust-tight case and runs in an oil bath.

Power is transmitted from the reverse gear differential to



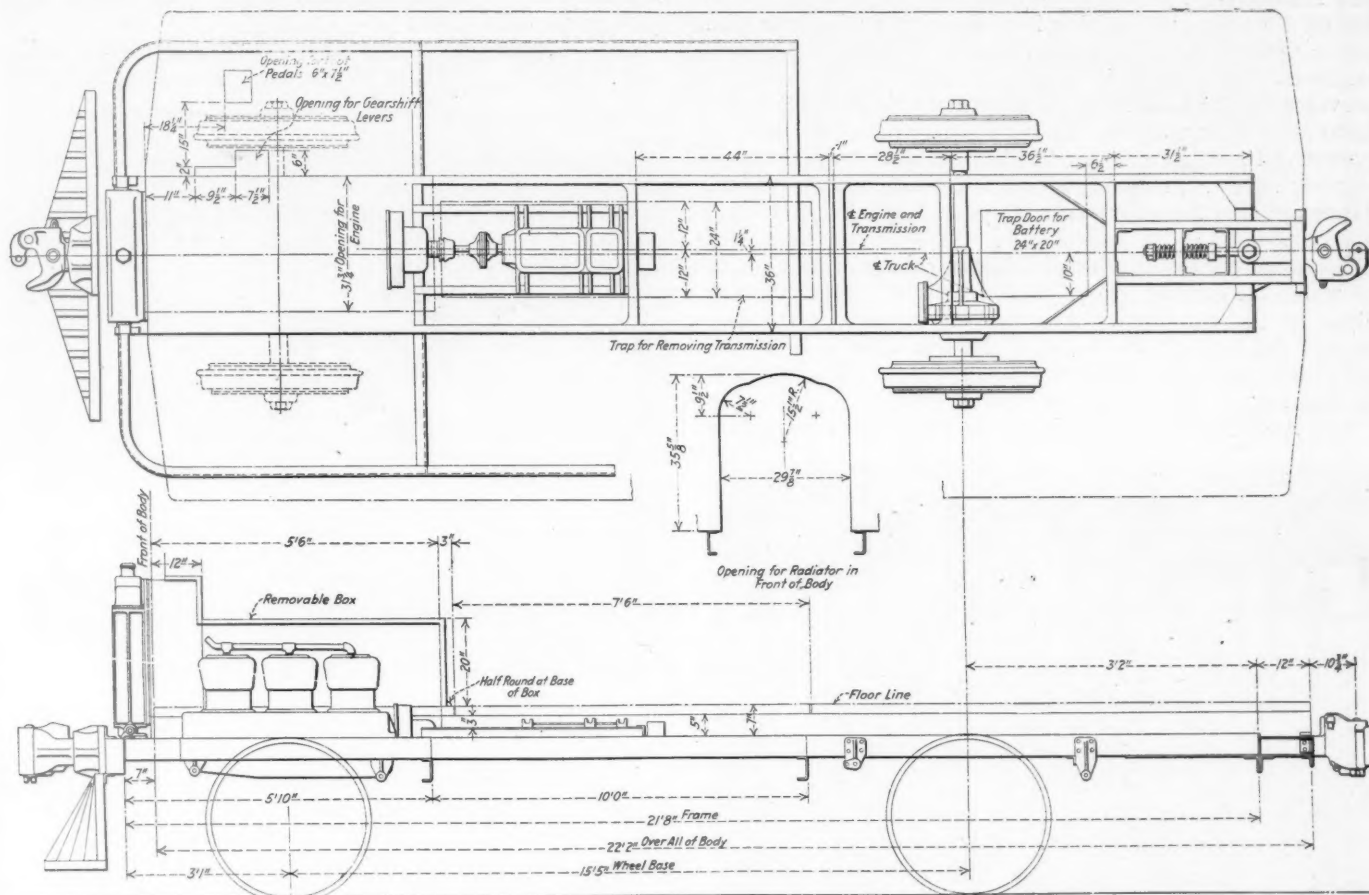
The Convenient Location of Operating Valves and Handles Is Apparent

the axles through propeller shafts, each containing universal joints. These have hardened steel bushings and pins and are thoroughly housed in dust-proof, oil-tight casings.

Both front and rear axles are rigid like the rear axles on a truck and are of the full floating type. Each axle contains a differential through which the power is transmitted to the driving wheels. These axle differentials are also completely enclosed in oil-tight, dust-proof housings and run in an oil bath. The weight of the car is taken on these housings and not on the driving axle. Each trailer axle is made of one

cast-steel, hollow-spoke type. Tires are of rolled steel and have the standard M. C. B. contour. They are 35 in. in diameter and are mounted the same as demountable solid rubber tires. Ball bearings are used throughout the clutch, transmission, reverse gear and axles.

Cast-iron brake shoes are used on all four wheels, there being one brake shoe for each wheel. A Westinghouse air

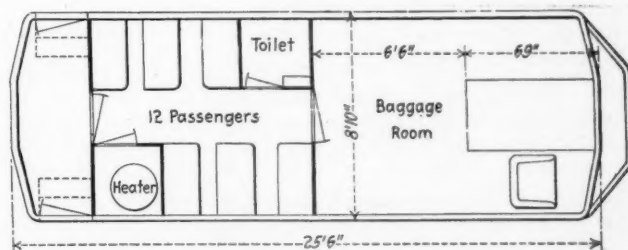
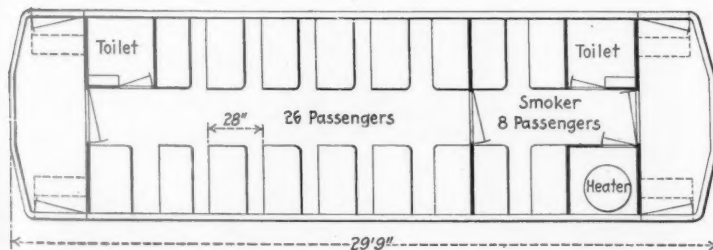


Chassis of the Motor Car

piece of cold drawn tubing, of 4 in. outside diameter and 3/4-in. walls. This tube is turned at the ends to accommodate the spring seats and the roller bearings on which the wheels are mounted.

Springs for both the power unit and trailer are 54 in. long, 2 1/2 in. wide and are made of chrome silicon manganese steel, heat treated. These springs are connected to the chassis

brake system is provided with an air compressor installed at the rear of the transmission. This compressor has a capacity of 10 cu. ft. per min. and is controlled by an automatic governor. An air strainer at the intake prevents dust and dirt reaching the cylinder. This brake system is provided with all necessary safety valves, emergency valves, operator's valves, application valves, etc. It is a two-pipe



Seating Arrangement of the Mississippi Central Motor Train

frame with double-swing shackles which allow the chassis to swing slightly sidewise, thus cushioning the side impacts against the rail and improving the riding qualities of the car. The action of these shackles is very similar to that of the swinging bolster used in railroad cars. The axles are held in place by radius rods, by the adjustment of which the wheels can be brought into accurate alignment.

The wheels for both the power unit and trailer are of the

system similar to that used on street cars, with a direct air system for service applications and an indirect system for emergency.

One sand box, 7 in. by 10 in., is placed at the rear of each rear wheel and at the front of each front wheel. The flow of the sand from these boxes is governed by an air valve at the driver's seat with air supplied from the air brake system.

Standard M. C. B. couplers are used, the front coupler

having a reinforced wooden filler block and being bolted rigidly to the front of the chassis frame. The rear coupler is of the spring type. The front guard is made of white oak, reinforced and braced in a substantial manner.

A two-unit starting and lighting system is furnished, consisting of a starting motor which operates on the fly wheel of the engine through a Bendix drive. A 270-watt generator and 225-amp.-hr. storage battery are used, the system operating on 12 volts. The wiring is of the single wire type with return through the frame of the chassis. All wires are heavily insulated and carried in steel conduits. Connections are provided for the head light, sufficient body lights, the driver's instrument light and rear marker lights. With this lighting system is furnished one head light, one instrument lamp, a lighting switch, an ammeter and a reverse current cut-out. There are also two oil marker lamps and four marker lamp brackets.

With the chassis is provided in the exhaust line a valve by which the exhaust gasses can be shunted through heating pipes in the car body. A series of wrought iron pipes is provided beneath the seats at the left hand side of the body and connected with the heater valve. A hot water heating system can be furnished if desired.

The maximum drawbar pull, as shown in the accompany-



Interior View Showing Walk-Over Seats and Luggage Racks

ing table, is 3,780 lb., obtainable with a gear ratio of 29.40 to 1 in low. The maximum speed with this gear ratio is 5.3 miles an hour and the drawbar pull of 3,780 lb. is obtainable at two-thirds of the maximum speed or about 3.5 miles an

GEAR RATIOS, DRAWBAR PULL AND SPEEDS OF THE TWO-CAR MOTOR TRAIN

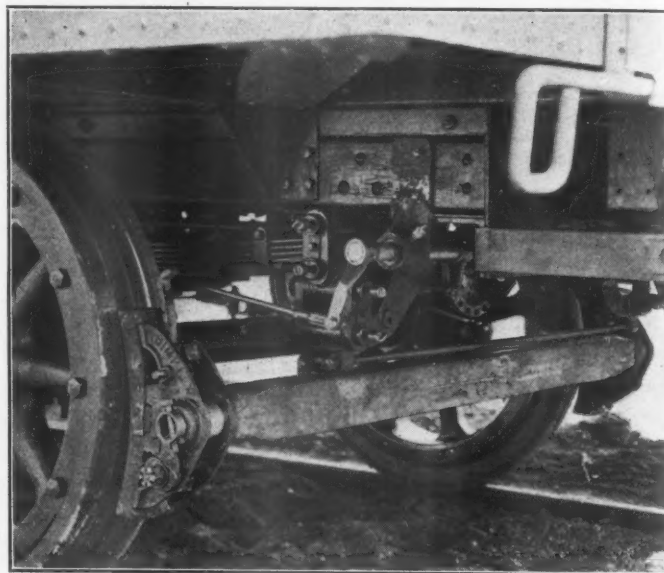
Gear ratio	Transmission reduction	Drawbar pull at $\frac{2}{3}$ max. speed	Max. speed in miles an hour
Ratio 3.9 to 1 in high			
15.6 to 1	Low	2,000 lb.	10 m.p.h.
7.8 to 1	Second	1,000 lb.	20 m.p.h.
5.4 to 1	Third	680 lb.	29 m.p.h.
3.9 to 1	High	500 lb.	40 m.p.h.
Ratio 5.0 to 1 in high			
20.0 to 1	Low	2,580 lb.	7.75 m.p.h.
10.0 to 1	Second	1,290 lb.	15.5 m.p.h.
6.86 to 1	Third	784 lb.	22.6 m.p.h.
5.0 to 1	High	645 lb.	31.0 m.p.h.
Ratio 5.65 to 1 in high			
22.60 to 1	Low	2,930 lb.	6.8 m.p.h.
11.30 to 1	Second	1,460 lb.	13.75 m.p.h.
7.76 to 1	Third	1,000 lb.	20.00 m.p.h.
5.65 to 1	High	730 lb.	27.5 m.p.h.
Ratio 7.35 to 1 in high			
29.40 to 1	Low	3,780 lb.	5.3 m.p.h.
14.70 to 1	Second	1,880 lb.	10.75 m.p.h.
10.00 to 1	Third	1,275 lb.	15.00 m.p.h.
7.35 to 1	High	940 lb.	21.5 m.p.h.

Note—This drawbar pull is the maximum obtainable. A working safety factor of 20 per cent should be allowed from these figures.

hour. With a gear ratio of 15.6 to 1 in low, a drawbar pull of 2,000 lb. is obtainable at about 6.6 miles an hour.

The general dimensions of the passenger-baggage car are as follows: Length overall, 25 ft. 6 in.; width of sheathing, 8 ft. 10 in.; from rail to top of floor, 3 ft. 8 in.; from rail to top of roof, 10 ft. 3½ in.; post spacing, approximately 2 ft. 4 in.; from floor to top of window rest, 2 ft. 4 5/16 in.; from floor to bottom of Gothic sash, 4 ft. 2 7/16 in.; width of door opening in clear, 2 ft.

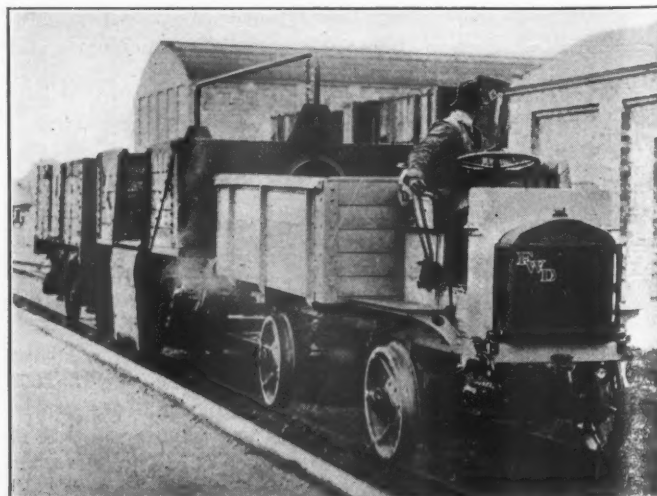
The following are the general dimensions of the trailer body: Length overall, 29 ft. 9 in.; width of sheathing, 8 ft.



This Illustration Shows the Brake Beam and Brake Shoe Arrangement and the Double Swing Spring Shackle

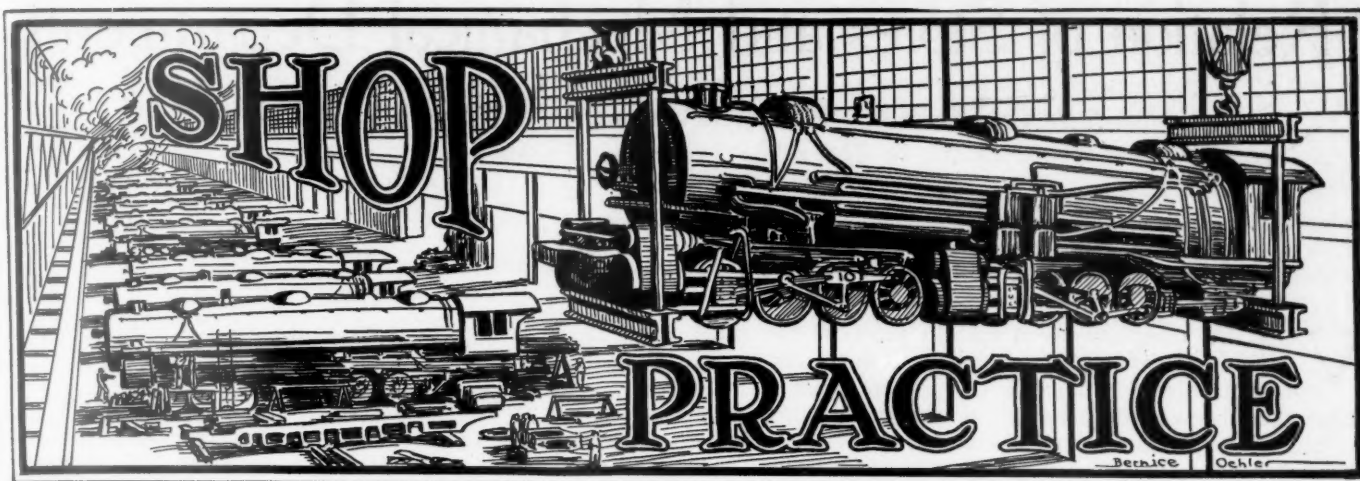
10 in.; from rail to top of floor, 3 ft. 8 in.; from rail to top of roof, 10 ft. 3½ in.; post spacing, 2 ft. 4 in.; from floor to top of window rest, 2 ft. 4 5/16 in.; from floor to bottom of Gothic sash, 4 ft. 2 7/16 in.; width of door opening in clear, 2 ft.

The inside of the cars are oak grained with the head lining painted white. The sashes are mahogany grained. The outside of the cars are painted in Pullman body color, with black roofs, Pullman truck color platforms and black enameled iron work. They are lettered and striped with imitation gold paint.



P & A

A Convertible Highway-Railway Motor "Lorry" Used in England



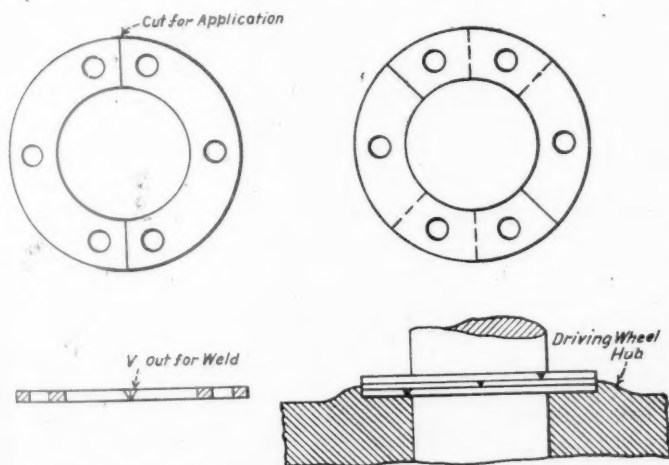
A Successful Locomotive Hub Liner Practice

By H. L. Lucks

General Foreman, Erie, Dunmore, Pa.

THE best type of locomotive hub liners and the method of applying them have been, and still are, quite important questions. This is particularly true in regard to the means used for anchoring when applying them in the roundhouse when the engine is in for boiler washing.

A substantial and lasting liner, which has given excellent service and is applied easily, is shown in the illustration. It is made from $\frac{1}{4}$ -in. steel plate cut out to the size of the recess or the face of the driving wheel hub, and with an



Hub Liners Are Made From $\frac{1}{4}$ -In. Steel Plate Built Up to Desired Thickness

inside diameter suitable to go over the axle, as shown in Fig. 1. The liners then are cut in two, beveled at the joint and three 1-in. holes drilled in each half. The first half of the liner is applied by electrically welding it to the hub through the holes and tack welding it on the outer circumference. The engine is then moved, the other half applied in the same manner, and the joints between the halves welded up. The next liner is now taken and similarly applied with its joint overlapping the joint of the first liner, as shown in Fig. 2. This process is repeated until the desired thickness is obtained. The method described is applicable, of course, only to steel driving wheel centers as the electric weld will not tack or fuse to cast iron with suffi-

cient certainty to make the method a reliable one in such cases.

These liners can be carried in stock and then it is a matter only of pulling down the binder and removing the driving box cellar to perform the operation.

Function of the Shop Schedule

By H. V. Styers

HOW does a schedule system apply to repair work on a locomotive? First, you must have a planning department to lay out the work and check up materials, castings, boiler sheets, wheel centers, and various other units that are used in the repair of a locomotive. With a production board properly laid out with the dates of actual working days, the locomotive can be entered, together with the dates when the various operations must be completed in order for the locomotives to go out on time. The operations must be listed in their proper order. For instance, the boiler lagging can not be put on before the boiler is tested, nor is the locomotive painted before all the parts are completely assembled, and all piping in place.

Now the question comes up, what is the erecting shop going to do in case the machine shop does not deliver the rods or pistons and crossheads? There must be a reason why the machine shop foreman did not deliver these parts on schedule time and the man who looks after material reports that bushings of the proper size were not available in the storehouse. The storekeeper is immediately notified and orders placed. In the meantime, the production board shows that the rods were not delivered on time and in the morning when the shop superintendent comes in, he looks at the production report which shows only jobs which are behind. He can then get busy with the responsible foreman and either substitute materials, or get material from some other locomotive of the same class.

With a properly maintained schedule board, it is possible to put as many locomotives out of the shop the first week of the month as it is the last when everybody is working to keep the reputation of the shop and the company is paying time and one-half for overtime. Work can be planned just as well in a repair shop as in a manufacturing shop. Work dates should be established by the shop superintendent and changed only by him as he is responsible for the output of the shop. When manufacturing companies pay large salaries to men as production managers and maintain large clerical forces to enter and execute their orders, it surely is advisable for railroads to look after their planning and bring it up to a point of greater efficiency than is now common.

Relation of Stores and Mechanical Departments

Wrong Conditions Are Reflected Upon the Shop Payroll As Well As
Upon the Inventory Sheets

By F. M. A'Hearn

Assistant General Foreman, Bessemer & Lake Erie, Greenville, Pa.

VARIOUS tales have been told to illustrate the value of united effort by the different departments of an organization. In no case is unity of effort of more value than between departments of a railroad, this being particularly applicable to the relations of the stores and mechanical departments. Railroads are engaged in selling one thing only—transportation. Were their principal business selling the output of the shops or retailing quantities of materials, then the department which provided the principal reason for the company's existence might well consider its affairs and wants to be of highest importance. We can readily see the folly of the time and effort wasted where each department is inclined to consider only its own interests regardless of its bearing upon the remainder of the organization.

It is not to be implied that railroad officers approve of such actions, nevertheless rules or instructions carried out to the letter must also be carried out in spirit, otherwise the company is not receiving fair treatment. The stockholders,

wise from the same fund are paid the losses caused by either department.

Staff Meetings Reveal Lack of Co-operation

Meetings of railway shop supervisory staffs frequently find such subjects as obtaining material and the delays incidental to the failure of the stores department to provide material, topics of importance. In such meetings where stores department representatives are present, the responsibility of such failures is handed back and forth, or "the buck is passed" to considerable extent. The mechanical department endeavors to prove their side by showing the amount of material ordered and the number of days that have elapsed since the orders were forwarded to the stores department. The stores department in turn produces evidence to show that the requirements of the mechanical department have been in excess of all previous requirements for that period of time. They usually contend that they are unable to prepare for unusually heavy demands for certain stock without being



Aeroplane View of the Bessemer Shops at Greenville, Pa.

who are our employers, furnish the capital and assume the risks of loss incidental to conducting a business. To them the mechanical and stores departments are equally responsible, and from the common fund earned by their investment, the wages and expenses of each department are paid; like-

given sufficient advance notice. In addition to this, delayed deliveries from manufacturers are frequently the cause of shortage in stock.

All of this debate, while of interest, does not place the material at the points awaiting it. It is evident that we may

have two departments not working for the common good. The mechanical department endeavors to show that the stores department is responsible for delays on account of the lack of material. Possibly substitutions could be made but these are not wanted, for shifting the blame to the other department provides a smoke screen for certain omissions or shortcomings in its own organization. On the other hand, the stores department in order to show small inventories and low inactive stocks, may pare the requisitions too closely to the detriment of the mechanical department.

Determining Future Requirements

In order that fewer delays occur in the mechanical department and that the minimum amount of stock be carried in the

smaller parts which can be finished to size, such as eccentrics, main rod bearings, driving boxes, driving box shoes and wedges, driving box saddles, crosshead shoes and gibs, valve gear parts, and innumerable other parts, can be finished in production quantities and carried in stock.

Method of Handling Firebox Renewals

Information concerning the practice of the Bessemer & Lake Erie in handling certain stocks of material was obtained from Guy M. Gray, superintendent of motive power, and R. McAndrew, general storekeeper, both of whom are located at Greenville, Pa. The system by which the stores and mechanical departments of that company co-operate with firebox renewals, as an example, is as follows: A record is made

Form 31 S. D. (Revised 4-22) 5M 9-23 By P. Co. No. 1 R. R. Manila 16 lb

BESSEMER AND LAKE ERIE RAILROAD COMPANY

Class _____ STORES DEPT _____ 192 _____ Material Order No. _____

To _____

PLEASE MAKE THE FOLLOWING ITEMS CHARGE ALL LABOR AND MATERIAL USED IN THE WORK TO M. O. No. SHOWN ABOVE.

Quantity	DESCRIPTION	Kind of Material Used	MATERIAL CHARGE			LABOR CHARGE				Shop Expense	Net Cost	Account to be Given Credit
			Total Wt or Measure	Price	Amount	Hour	Min.	Rate Per Hour	Amount			

GSK. _____ M. M. _____ M. O. B. _____

Order Assigned To _____ Date _____ Completed _____

Form 31 S. D.—Used by Stores Department for Ordering Material from the Shops

stores department, let us consider the following practice: The mileage that should be obtained from locomotives of a certain class during the interval between classified repairs, is determined by past performances. It is not a difficult matter to make a record of each locomotive at the time of monthly inspection by noting the principal conditions that determine the service period between shoppings, such as fireboxes, flues, tire wear, machinery, etc. From this information we can determine approximately the date when the locomotive will be held from service for classified repairs. Many parts that

at the monthly inspection of each locomotive, giving in a condensed form the condition of the machinery, driving boxes, rods, flues, fireboxes, and tires. This information is entered on a 3-in. by 5-in. card and filed in the usual manner. At the end of each month a sheet is prepared showing the months of service each locomotive is expected to perform before



Interior View of Erecting Shop

are not regular stock or are not frequently required, such as cylinders and frames, may be ordered several months in advance for delivery in ample time for application. The



Fig. 1—Type of Trucks Used for Platform and Runway Deliveries

shopping. During the three months prior to shopping, the class of repairs the locomotive will receive is entered on this sheet.

In addition to this information, records are kept giving the date of application of each firebox, and after a certain term of years, an estimated date for firebox renewal is made. With this data available, a fairly accurate program for firebox applications to certain classes of power covering a period of from six to twelve months in advance is developed, and

arrangements are made with the stores department for delivery of certain amounts of material at specified times.

A firebox material bill for each class or type of locomotive is furnished the stores department. The bill specifies the numbers and dimensions of the sheets, length, diameter, kind, and number of stays, sizes and amounts of rivets, size and number of arch tubes, and size and number of flue ferrules. Each bill covers sufficient material for one locomotive. In this manner the stores department is enabled to carry sufficient material for current requirements without having a large amount of inactive stock on hand at any time and without having unused stock remaining at the completion of the program of work.

When the material is received, the stores department, upon request of the mechanical department, issues a material order on Form 31 S. D. to the shops to build the required fireboxes. The various departments of the shop that have work to do in connection with the material order are given duplicates of the original. All time and material consumed are reported to the stores department with the return of Form 31 S. D. The completed fireboxes are carried as units on the stores department stock books to be issued together with one



Fig. 2—Interior View of Shipping and Receiving Department

bill of miscellaneous parts when a firebox application is made.

After the completion of the stated program, the items shown on the material bill are not carried in sufficient quantities for firebox renewals, but only in sufficient amounts to cover the regular 30 or 60-day demand if any such demand exists. The material bill referred to is developed from drawings and records of the detailed parts needed for one firebox application. Fig. 5 is a drawing made up by the mechanical department from which the stores department can determine the number, length and style of staybolts required for a firebox on certain classes of engines. The drawing consists of an approximate layout of the crown sheet, door sheet and throat sheet showing the location of the various lengths and styles of staybolts used. The number required can be readily determined by referring from the layout to the table on the same drawing. The shop builds the firebox or fireboxes, which are then carried on the stores department records as units ready for delivery to the shops, the same as if purchased from outside shops.

System for Delivering Material

All material is delivered to the shops by the stores department, and all scrap is removed from the shop by the stores department. The plant is equipped with a private telephone exchange, enabling the placing of all orders for ma-

terial by telephone. The delivery clerk fills out the order as phoned. The order is signed by the foreman upon receiving the material, who notes thereon the time received. Delivery trucks are operated on a schedule of two hour intervals to all departments. As a further protection against delays, special deliveries are made upon request. The time required between the placing of an order and receiving small



Fig. 3—Storing Kegs of Rivets with a Tiering Machine

materials on special delivery orders is usually from five to ten minutes, delivered to any part of the plant.

Stores Department Provides Excellent Facilities

The storehouse is of reinforced concrete construction, two stories in height, with a one story annex extending beyond the main building. It is centrally located with respect to all departments of the shops, which facilitates the delivery



Fig. 4—Style of Stock Bins Used in B. & L. E. Storehouse, Greenville, Pa.

of material. Suitable runways are provided from the storehouse to all points served by the delivery trucks. The type of trucks used for platform and runway deliveries are shown in Fig. 1. The stack bases loaded on the truck have been machined for the stack joints and drilled to fit to the smokebox. Fig. 2 is an interior view of the storehouse at the shipping and receiving department. The work tables or counters are of sheet steel and were constructed in the company shops. Fig. 3 shows a truck man storing kegs of rivets with a tiering machine, built by the Economy Engineering Co., Chicago. The racks are made of standard steel shapes,

which were also constructed in the shops of the company.

In Fig. 4 we have an illustration of the excellent facilities provided for the handling of material in stock. In the bins in the foreground are various types of locomotive driving box or spring saddles, machined to size and ready for application. The proper identification appears upon each bin, which gives the name of the article, drawing number and line number of the drawing. In the lower row of bins is a stock of crosshead wrist pins rough turned on the body, but threaded

to take the place of two or more items that are carried, where one item would be sufficient. Fractional lengths of bolts, both finished and rough sizes, are standardized to simplify the storekeeping. This is typical of innumerable other cases. Any stock of inactive material that may be accumulated is carefully investigated by representatives of the stores and mechanical departments. The inactive material list is kept as low as possible.

In order to avoid carrying any unnecessary material, the

NUMBER OF STAYBOLTS REQUIRED																									SYMBOL ON DIAGRAM	LINE	STAYBOLTS	
TOTAL	29"	27"	26"	25"	24"	22"	20"	19"	18"	17"	16"	14"	13"	11½"	11"	10½"	10"	9½"	9"	8½"	8"	7½"	7"	6½"	SIZE			
37																				23		14		1"	●	1	Common	
358		46	46	46	46	46	46				46		36												1½"	○	2	Crown
12										6		6													1½"	●	3	Flexible
957													10	8	32	40	62	152	169	166	186	132			1"	×	4	Flexible
6																				4	2				1"	⊗	5	Flush Flexible
36								12	6	6		6		6											1"	⊙	6	Expansion Stays
36																									1½"	⊙	7	Expansion Stay Stirrup

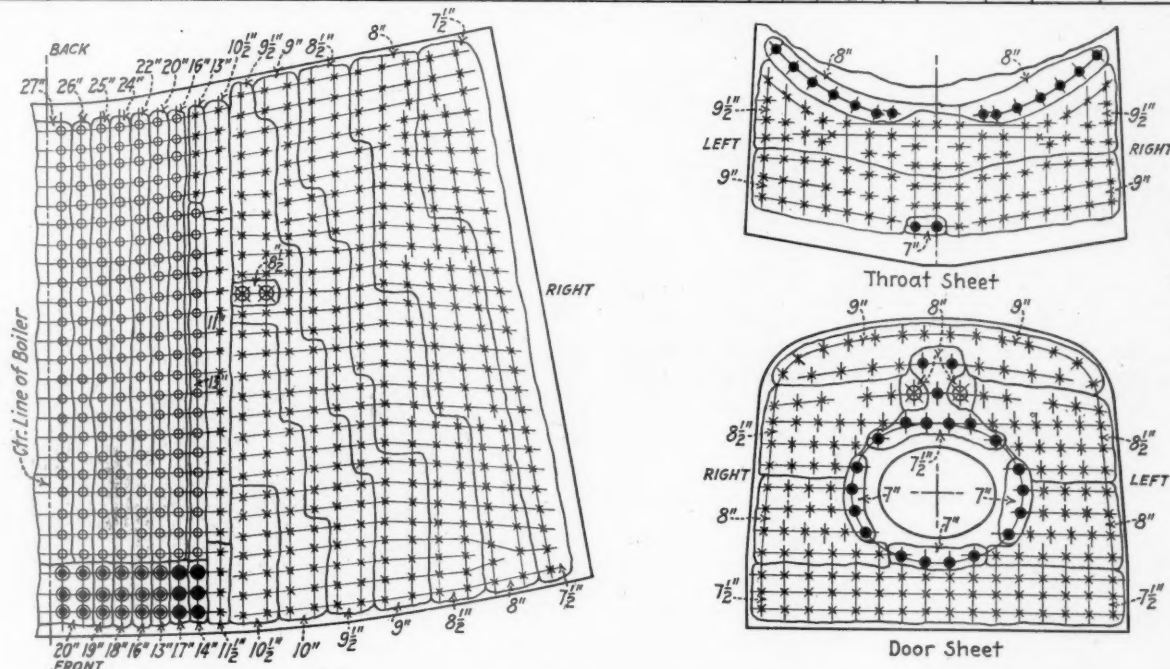


Fig. 5—Drawing from Which the Stores Department Can Make Up Material Bill for Staybolts

and ready for fitting to the crosshead body. In the bins beyond are main rod keys and wedge blocks, wedge bolts, key washers, and various small parts used in rod work. All parts are identified in the same manner as described in the case of spring saddles. There are also in this section spring hangers of various kinds, king bolts, driving spring equalizers, etc.

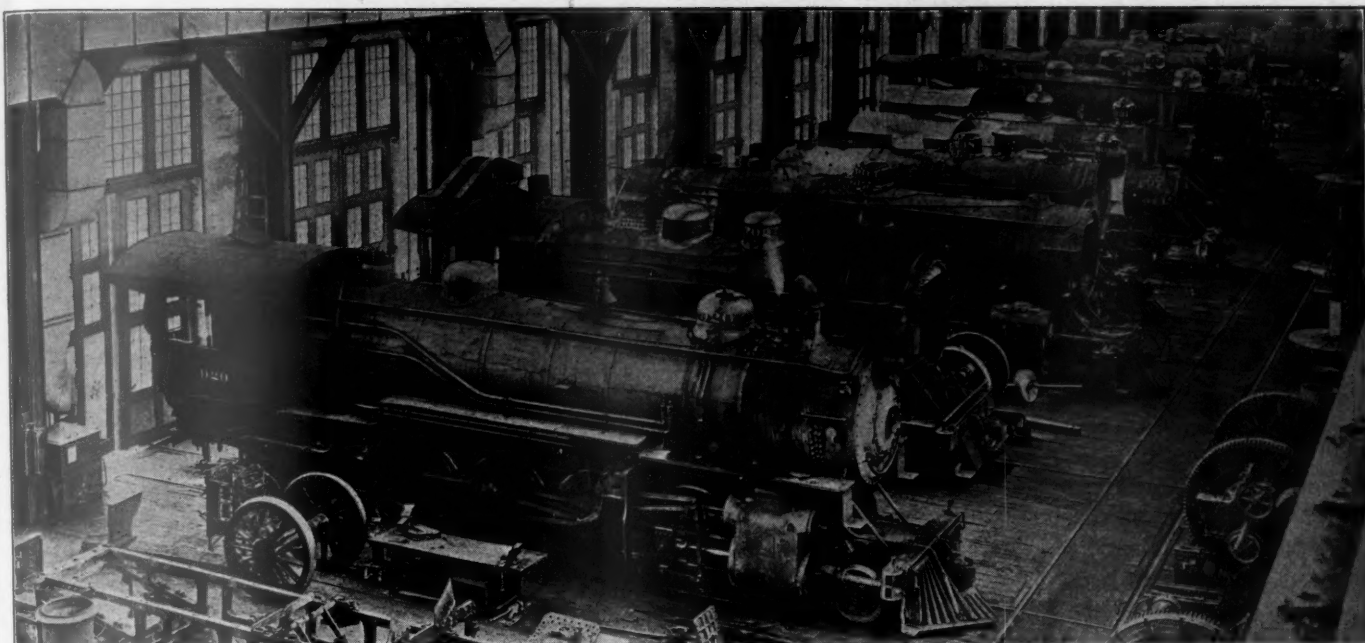
Amount of Material in Stock Kept Down

The stores department endeavors at all times to keep all stocks of material completed and ready for application as far as possible. At the same time the shops make a special effort to complete promptly and return all orders for the manufacture of material requested by the stores department. It is the practice to keep the amount of stock as small as possible, when by slight alteration a piece can be redesigned

stores department will not add any items to its lists to be carried as regular stock unless by written request of the mechanical department. It is not considered necessary to carry a piece requiring an issue of one in six or twelve months as a precaution of what might occur. In order to be protected against a delay at some future time, it has been found to be bad practice to order two pieces of any kind of material when the first failure of the piece occurs. Such a practice will in a short time load the stores department with thousands of dollars' worth of inactive material, which in the course of time becomes obsolete. This is the usual result of such a safeguard against a contingency that never occurs.

Finished Stock on Hand Ready for Application

As an illustration of how the mechanical department functions in having finished material on hand, the writer will cite



Erecting Shop Practices—Good and Bad*

Facilities and Organization Necessary for Efficiency; How to Extend
Mileage Between Shoppings

By Charles Riatt

Assistant Master Mechanic, Atchison, Topeka & Santa Fe, Prescott, Ariz.

THERE is no department of railroad work where organization and systematic methods are so essential to economic production as in the locomotive erecting shop. Given the normal capacity of the shop and the output desired, the labor cost and to a large extent the class of work done depends on the two factors—facilities and organization.

Poor or inadequate shop facilities and poor organization, which means failure to make the best use of force and facilities, spells high labor cost with the added cost which results from holding power out of revenue service, which in turn demands a larger number of engines to handle a given business. The erecting shop is therefore a potent dividend producer or reducer according to its efficiency.

Generally speaking, facilities are increased to keep pace with the output expected, but there are loose ends or practices in organization and methods which materially affect output as well as the quality of the work done in erecting shops, and I wish to mention some of these as I have observed them, rather than dealing with any one or more particular phases of general repair work.

Where Management Counts

Engines should come to the shop in such numbers and sufficiently in advance of the time when shop stalls will be vacant to allow for their being stripped and prepared for their place so that shop space will be fully occupied at all times. Time lost here cannot be recovered. Work reports outlining the class of repairs required should reach the shop sufficiently in advance of the engine so that all new parts required can be ordered and got moving in order to avoid

delays for material. The improvements and new appliances called for on nearly all engines coming to the shop make a 90-day advance shopping program the least that can be considered.

Efficiency and Economy

Efficiency and economy should begin in the stripping department. Too much rough stuff is the outstanding sin of stripping gangs and it is too often due to a lack of the proper tools for handling their work. Sledge hammers and chisel bars as stripping tools often send more material to the scrap heap than years of road service.

Shortage of tools in this department is often aggravated by lack of proper toolroom space. The stripping gang should not only have its own tools, but should have a good toolhouse with sufficient room for arrangement of tools so that they can be found readily when wanted. Tool foremen should make a weekly inspection and see that all their tools are kept up to requirements as in this respect stripping gangs are too often left to "a go as you please system."

Engine Stripping

A power device should be available at stripping tracks so that engines can be spotted for removal of rods and other parts without having to resort to pinch bars, and where stripping gangs do not handle sufficient work to justify specialists, the regular shop force should do all stripping of boiler mountings, electrical parts and air appliances as expert handling of these parts will avoid damage to material which will more than offset the added cost.

After all parts are cleaned, all large parts should be stencilled with the engine number or the pit number to which

*Awarded honorable mention in Erecting Shop Competition.

the engine is assigned and a tin tag bearing the same number should be attached to the smaller parts before delivering them to the various sub-departments so that labor and material costs will be correctly charged.

Order in Handling Repairs

The date an engine is expected out having been set, all parts delivered to the several sub-departments should be lined up in their order out in relation to other engines and an inspection made by the foreman to determine what new material is required, a list of which should immediately be passed to the material supervisor who should at once see that it is protected by store department stock. A date should then be set for the completion of the various parts in the order they will be wanted for assembling and it is good practice to have a schedule board at each of these sub-departments showing the completion dates of the parts they handle, independent of a general or central board that may be used for such data.

Routing Work Through the Machine Shop

Each sub-department should have the machines required to handle their work located conveniently to save long hauls and so that foremen interested can readily see that it is handled in the order and manner desired. It is also desirable that the sub-foremen should have charge of all the machines so assigned. This is quite practical where general repair schedules are not broken up to meet urgent demands for machine work from the roundhouse—a condition which all of the smaller and many of the larger repair shops have to meet daily. The same trouble arises in shops where system shop order stock is maintained by machines required for general repair work and the machine foremen's morning and evening devotions have very often to be augmented by hiding out periods during the day to escape the wrath of the foreman whose work is delayed. Where possible, therefore, machines should be assigned to roundhouse and stock work exclusively.

Maintaining Standards

All engines getting general repairs should be restored to standard dimensions in all important particulars and to that end standard prints must be available as well as master trammels, gages, etc. This applies particularly to spacing of driving axles, spread of guide bars, length of valve motion parts, piston rods and valve stems, spring hangers and equalizers, etc., as only by this practice can replacement parts be carried to cover breakdowns in service. No condition should excuse a departure from this practice.

Next in importance is the checking of all frictional or wearing parts, such as axle journals, crank pins, piston rods and all carrying gear to see that they are not worn below the safe limit for service. When such parts are approaching the scrapping limit, they should be renewed rather than spend time and labor on them, especially if related parts are renewed, as uniform conditions insure against breakage.

Treatment of Parts to Be Reused

As all revolving and reciprocating parts of a locomotive are subjected to vibration and also to heavy strains which tend to crystallize the metal as well as develop fractures, it is a good practice to anneal all these parts when engines are in for general repairs. Spring hangers and equalizers also should get this treatment. This not only restores the strength of the metal but reveals defects which can be corrected at much less cost than at any other time.

At small shops where furnaces for this treatment are not available, side and main rods and spring rigging parts can be annealed very well by arranging them on old rails set on fire brick supports about 2 ft. above the ground, using scrap wood for a fire.

Valve stem ends and piston rod ends also should be an-

nealed and examined for defects while hot as the draw of keys at sockets and crossheads often ruptures the material at the end of the keyway. This is the surest method of discovering such weakness.

All water, air and oil pipes that are to be used again should be cleaned of all rust and sediment before reapplying them. This usually can be done by hammering and then blowing them out with air pressure or, better still, washing them out with water pressure. All copper pipes should, of course, be annealed and tested before they are covered.

Where Experience Counts

In spite of the best intentions in the world, there are things that escape correction for lack of thought. It should not be taken for granted that driving journals do not need turning because they are smooth and parallel, nor that crank pins do not need attention because they have the same good appearance. These parts bear the whole thrust of the engine and if they have been in service two or three years, there is a flat or worn side that will start the driving box pounding or the rod bearings cutting before they run a thousand miles and the roundhouse force will be fighting them at big expense of material and labor until the engine comes back to the general shop and has these parts turned.

If an engine has a record of repeated trouble from side rods breaking or unequal wear of tires, crank pins should be tested for throw and quarter and this test should always be made when new crank pins are applied. Locomotive builders sometimes make mistakes that run for years before they are discovered, therefore nothing should be taken for granted that can be tested.

When new cylinders are applied, it is good practice to check steam ways for area and see that they are thoroughly clear.

Too much hurry when boring old cylinders and valve chambers costs money for lubrication and valve and cylinder packing. A smooth finish and a uniform size can be made much cheaper with the boring machine than by the action of valves and pistons.

Taper fits in crossheads and valve stems should have a perfect bearing and the taper of keyways and keys should correspond as a sure preventive against the pistons breaking in the crossheads. Proper fitting tapers between piston spider and rod are of equal importance and should not be slighted with the idea that the shrinkage will take care of a poor fit. It is a good guess that many of the unaccountable cases of spiders and piston heads breaking up in cylinders are due to the unequal stresses arising from these poorly fitted parts when under shrinkage strains.

Driving boxes should be tested for parallel with the cellars removed and after the brasses have been bored as the pressure at which brasses are pressed into boxes relaxes somewhat with boring and allows the box to close in at the bottom, thus causing a pound between shoe and wedge.

The application of driving tires is too often handled without a proper regard to the rules governing the size and shrinkage allowance. Loose tires are dangerous and in an effort to avoid them and be on the safe side an equally dangerous condition results from tires bursting or, what is still more common, the cracking of wheel spokes. When the pressure of tires is sufficient to bend steel spokes or to show the impress of the spokes on the axle through the hub—both of which conditions I have seen a good many times—cracked spokes is the inevitable result.

These scattered observations make no pretense of introducing anything new, nor of dealing with the most important phases of erecting shop work. Their object is rather to direct attention to certain rather common practices that creep into otherwise good organizations and seriously affect the maintenance cost of engines after they have been turned out for service, which cost is really the best and only criterion of erecting shop practices and efficiency.

Turning and Rolling Mounted Crank Pins

THE following description and illustrations of a device used in the Billerica Shops of the Boston & Maine for turning and rolling crank-pins while mounted in their respective driving wheels are made available for readers of the *Railway Mechanical Engineer* through the courtesy of T. Jennings, superintendent of shops.

Owing to the heavy weight of modern locomotive reciprocating parts and the tremendous pressures exerted on crank-pins in service, the latter are subject to more or less rapid wear, and the problem of maintaining the bearing surfaces of pins in true cylindrical form is a difficult one. Pins which are badly worn can be improved by filing, but it is difficult and in fact practically impossible to get an accurate cylindrical surface by this method. As a result the pins are usually either pulled and trued by grinding or in an engine lathe, or else put back into service in imperfect condition. In the latter case, rod bushings must be bored to the largest diameter of the worn pin in order to be applied and consequently have undue play at other points on the pin. Excessive bushing wear results, so that bushings fitted to worn pins frequently show as much wear after one week as they should after several months' service.

In view of the above facts, the importance of maintaining accurate, smooth crank-pins can be appreciated, and railroad men have long been on the lookout for some device for quickly and accurately truing the worn pins without removing them from the driving wheels. Portable machines for this purpose are available and greatly to be preferred to hand filing, but in general they are far lighter and less rigid than the device illustrated. In addition, portable crank-pin turning machines afford no provision for rolling after turning. Quartering machines are also sometimes adapted to turning mounted crank-pins, but in this case it is sometimes difficult to eliminate chatter and there is also no provision for rolling. The device shown in Figs. 1 and 2, however, can be used satisfactorily for both turning and rolling mounted crank-pins. It is powerful, accurate, easily adjusted and rapid in operation.

The device consists of a heavy, right-angle steel arm *A* (Fig. 1) of large proportions keyed to the outboard end of the boring bar *B* of a standard horizontal boring machine. This bar is counterweighted by means of weight *W* to compensate for the unbalancing affect of arm *A*, allowing a uniform turning moment to be transmitted to the boring bar. The driving wheel journals rest on a pair of V-blocks (one of which is shown at *V*) bolted to a rigid frame work *FF*, built up of 1-in. by 4-in. steel bars firmly riveted together. This framework is supported at a fixed distance from the boring mill on a substantial concrete foundation 3 ft. deep. The V-blocks are adjusted to be parallel with the boring bar, and the driving wheel axle is accurately leveled to take account of different journal diameters by means of suitable shims. Handle *H* extends to the standard operating handle of the horizontal boring machine, enabling the boring bar to be started and stopped while the operator remains close to the work.

Referring to Fig. 2, which gives a close-up view, the arrangement of the round-nose cutting tool *T*, tool block *M* and head *N* of the tool block adjusting screw will be evident. Tool block *M* slides in suitable ways in arm *A*, the radial position of the cutting tool being adjusted by turning head *N* of the feed screw.

In truing a worn crank-pin the first operation is to set the driving wheels on the V-blocks with shims to level the axle. The wheels are then removed until the crank-pin is in approximately the upper position, when two clamps *C* and *D* (Fig. 2) are applied over the spokes of the wheel as shown, the lower ends of these clamps being bolted to the built up framework with nuts providing for adjustment. In other words by loosening the adjusting nut which holds clamp *D* and tightening the nut which holds clamp *C* the crank-pin will be revolved away from the operator as he stands in Fig. 2. The driving wheel is therefore adjusted by this means until the crank-pin is in the same vertical plane as the boring bar. The boring bar is then adjusted vertically until its center line is at the same elevation as the crank-pin center line. Both of these determinations are made by means of a lathe center in the end of the boring bar which also fits in the crank-pin center hole when adjustments are correct. This setting of the boring bar and crank-

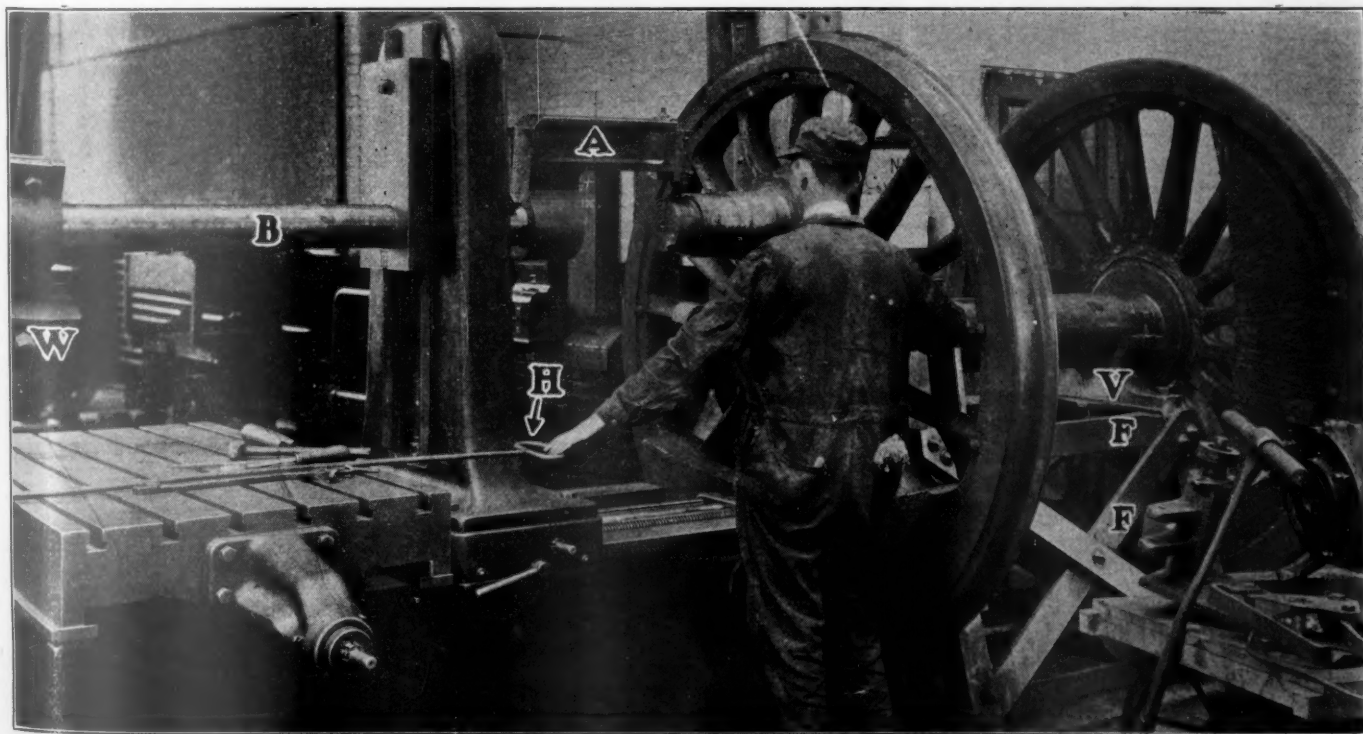


Fig. 1—Front View of Boring Mill Attachment for Turning and Rolling Mounted Crank-Pins at the Billerica Shops of the Boston & Maine

pin is checked, however, by revolving the boring bar and making sure that the cutting point of the tool moves in a circle concentric with the crank arm bearing surface. This surface has not been subject to wear or distortion like the crank-pin center and therefore gives a more accurate measure of the original center line of the crank-pin. It is essential to take these precautions in lining up the crank-pin and boring bar in order that the distance between the center of the pin and center of the axle may remain standard and not change the stroke of the piston.

Crank-pins must be renewed after being reduced through

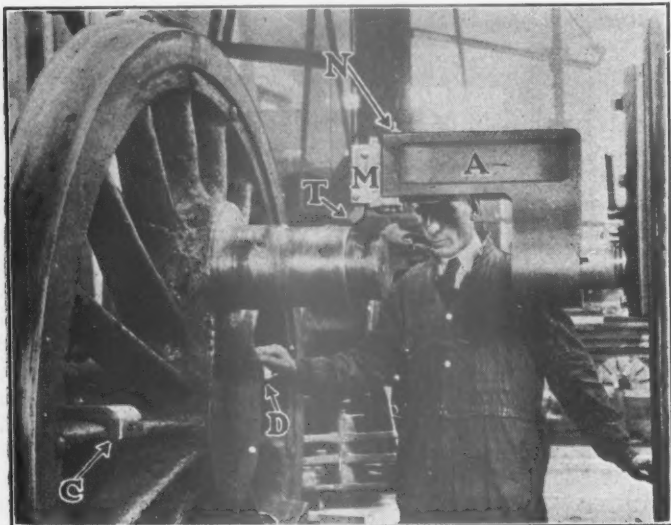


Fig. 2—Close-up View Showing Tool-holder and Adjusting Clamps

wear and machining to a limiting diameter and it is important therefore to remove as little metal as possible in truing the pins. The cutting tool is adjusted with this in mind. After the turning operation has been completed on both bearing surfaces of a pin, the cutting tool is replaced by a hardened steel roll and the pin rolled in accordance with customary engine lathe practice. The crank-pins on the pair of wheels illustrated, 9 in. in diameter, were turned and rolled in $2\frac{1}{2}$ hr., floor to floor.

Making Round Head Bolts From Bar Stock

By L. K. Silcox,

General Superintendent Motive Power, C. M. & St. P.

QUITE a saving is effected at the Milwaukee shops of the Chicago, Milwaukee & St. Paul by the use of round head bolts made direct from bar stock instead of the usual hexagon head forged bolts for locomotive frames and cylinders. An analysis of the operations required to make and fit a frame bolt by the usual method is as follows:

- | No. | Description of Operation |
|-----|---|
| 1. | Bar iron taken from stock pile to shear. |
| 2. | Cut to required length for forging. |
| 3. | Taken to forging machine. |
| 4. | Heated and headed. |
| 5. | Placed in store stock. |
| 6. | Sheared to length if exact length is not available. |
| 7. | Ends faced and centered on centering machine. |
| 8. | Moved to lathe. |
| 9. | Turned to size and length. |
| 10. | Moved to bolt cutter. |
| 11. | Threaded. |
| 12. | Returned to engine lathe. |
| 13. | Turned and fitted as required. |

The same results are accomplished in the round head bolt system in two operations, thus:—

- | No. | Description of Operation |
|-----|---|
| 1. | Bar iron from stock to bolt lathe. |
| 2. | Bolts completely turned and fitted on turret lathe. |

It is self-evident that there is a direct saving in labor of eleven distinct operations and of the use of three machines and one furnace.

Straight bolts are used for all frame and cylinder work except very long bolts in frame splices where extended taper bolts are used. Straight holes are reamed in groups to exactly the same diameter which permits the turret lathe operator to adjust turning tools for finishing the entire group without change in setup. It has been found that the advantage in time consumed in fitting bolts is at least 35 per cent in favor of the bar stock system, and that the efficiency of bolting is equal to, if not better than, the forged end engine lathe turned bolt.

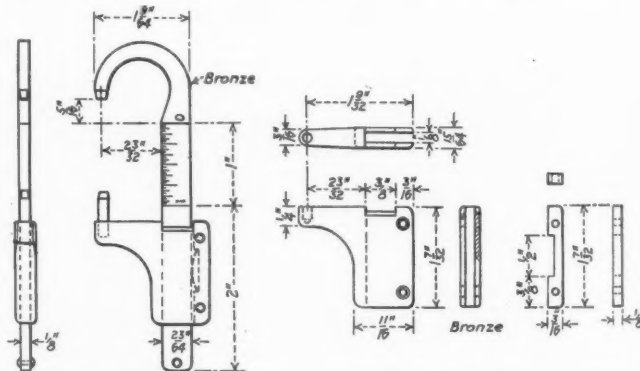
A greater advantage is also found in the simplification of the store stock, because bar iron only needs to be carried in stock as compared with the multiplicity of sizes and lengths of bolts that must be stocked when forged bolts are used. We have also found that there is a great possibility of wastage in not having the proper length of bolt in stock and cutting down longer lengths than necessary when odd sizes are required for immediate use.

There seems to be no good reason for the use of a hexagon headed bolt where the value of the bolt depends largely on the efficiency of the driving fit and the principal stresses are shearing. There is no occasion to turn or hold such bolts with a wrench. In some cases, it seems to be advisable to continue the use of the hexagon headed bolt, for example, engine truck and binder bolts which may be frequently removed in the course of roundhouse maintenance or where it may be desirable to be able to hold the bolt with a wrench to facilitate quick running repairs.

Boiler Plate Gage

By E. A. Miller

A CONVENIENT boiler plate gage for the use of inspectors and foremen is shown in the illustration, the goose neck effect being provided so that sheets having a



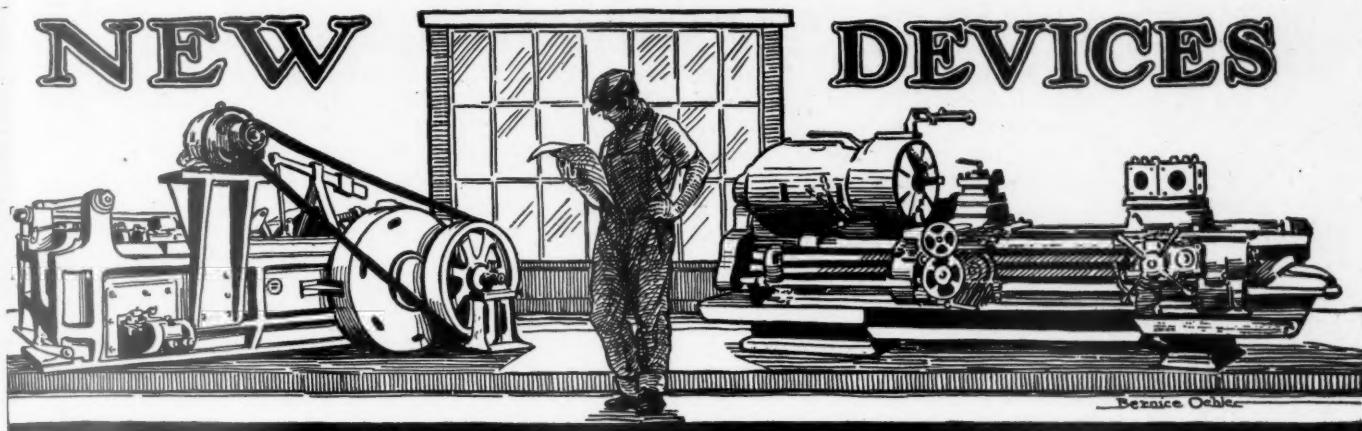
Simple but Convenient Boiler Plate Gage for Boiler Inspectors

rolled edge can be readily gaged. For plates thicker than 5/16 in. and having a rolled edge all around, a larger goose neck gage will be necessary of the same type as illustrated.

Referring to the illustration, the body of the tool is made of bronze, finished all over and graduated as shown. The slide likewise is made of bronze, slotted on one side to receive the filling piece after the small spring has been put in place. The filling piece is riveted using $\frac{1}{8}$ in. rivets in countersunk holes, the slide then being capable of movement on the body with just the required spring tension. A $\frac{1}{8}$ in. bronze stud or anvil $\frac{1}{2}$ in. long is sweated in the hole in the slide as shown in the assembly view. This anvil projects 5/16 in. beyond the slide so that when the caliper points touch, the slide is at zero on the scale.

This gage can be easily constructed and will prove a reliable and valuable tool for boilermakers and inspectors.

NEW DEVICES



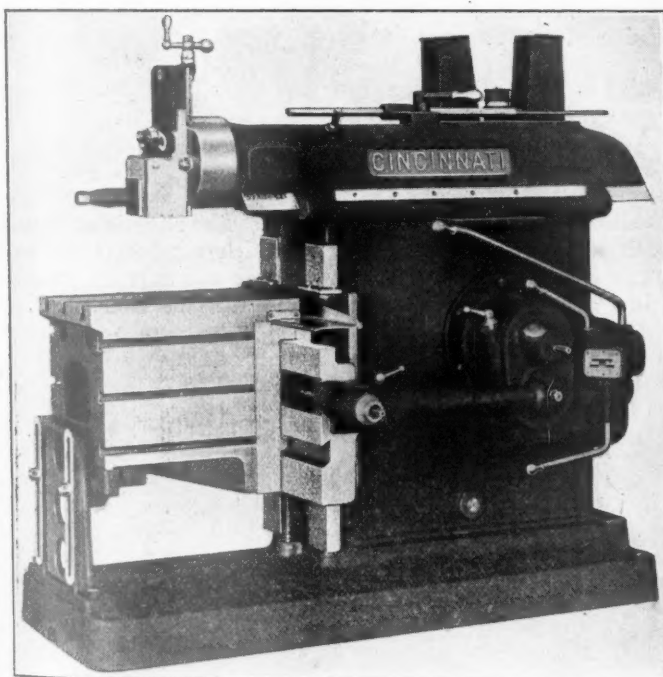
A Shaper With Several Unique Features

A NEW line of shapers, to be known as the Cincinnati Climax, is now being manufactured by the Cincinnati Shaper Company, Cincinnati, Ohio. These machines are built in seven sizes; namely, 16 in., 20 in., 24 in., 28 in., and 32 in. heavy duty type, and in two sizes, 20 in. and 24 in. of the standard type. These machines contain a number of unique features, one of which is the feeding

visible type which supplies oil to the bearing surfaces of the machine.

Eight selective changes of speed are provided, from 11 to 138 cutting strokes per minute on the 16-in. to 9 to 102 cutting strokes per minute on the 32-in. shapers. The levers for starting, speed control, feed engagement and variation, and ram and stroke adjustment are all easily reached by the operator without leaving his working position. Direct reading indicators for speed, feed and length of stroke are provided. The main crank gear is of the helical type and is made in one piece of semi-steel. All the other gears are made from chrome nickel steel and are heat treated. The gear chamber forms the reservoir for the oil used for lubricating both the drive gears and the balance of the machine. The machine is completely guarded both for the operator's protection against danger from moving parts and belts, and also for the protection of the sliding surfaces against chips.

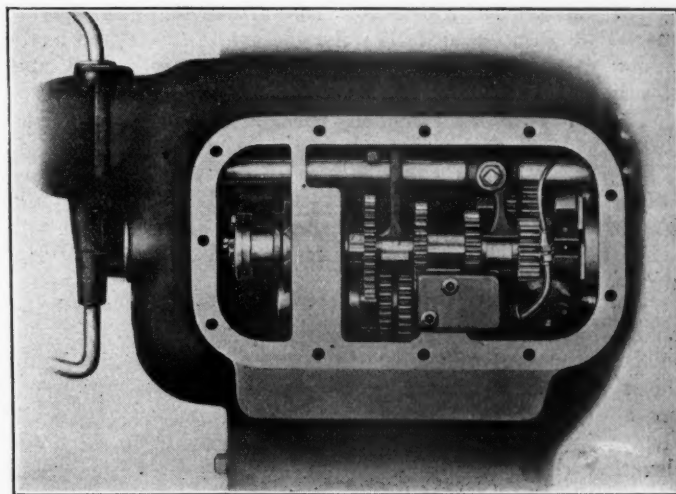
The drive is of the single-pulley type with friction clutch and brake. The pulley shaft is mounted on roller bearings. The machine may be driven by a motor mounted directly



Cincinnati Climax Shaper

motion that is actuated by cams and not by an eccentric and ratchet. This provides for a gradual, rather than for an abrupt feed, and it confines the entire feed under any condition wholly within the return stroke. Eleven feeds, ranging from .010 in. to .170 in., are provided. The feed variation is accomplished by means of a lever, mounted on a direct reading dial, indicating the feed in thousandths.

Another feature of the general feed arrangement is the omission of the usual feed box on the end of the cross rail. This mechanism has been placed on the side of the column in a position where it will not encroach upon the operator's working space. All speed and driving gears run in oil, slide on integral multiple key shafts and are placed within the column. The lubricating system is of the automatic



View of the Gear Box with Lid Removed

on pads provided on the back of the tool. The construction permits the addition of the motor at any time without difficulty. On account of being able to have both sides of the ram ways in the column cast solid with it and to provide for complete adjustment to the ram ways by means of a single screw, thereby taking care of any play in either a sidewise or a vertical direction, the V-type ram was adopted.

by this company. A guard that forms part of the ram prevents dirt from working its way into the bearings.

The length of stroke is maintained without the usual clamping nut on the stroke adjusting shaft, the purpose of the nut being fulfilled automatically. The indicator shows the setting for the length of stroke irrespective of whether the machine is running or not. The separate crank gear bearing permits a solid crank gear and makes possible a replaceable bushing as in other bearings. The tooth proportions adopted eliminate undercut in the pinion, provides full contact in action, and at the same time give equal strength in the teeth of the gear and pinion, which are of different materials. The crank gear journal is especially long and of two diameters. The purpose of the enlarged portion is to provide additional strength and bearing surface at the point of greatest strain, while the length of the smaller portion maintains the alinement.

A special feature is the close proximity of the crank gear bearing to the rocker arm. In addition, the gear portion of the wheel is made to overhang the bearing, thus bringing the driving load further within the bearing.

The crank pin, of drop forged steel, hardened and ground, is held in the dovetailed slide of the crank gear by a taper gib. The rocker arm is of a closed type, made of semi-steel. It is fulcrumed at the bottom, and connected to the ram by a link. The fulcrum and link pins are hardened and ground.

The sliding block is of gray iron, having a hardened and ground steel taper gib on its driving side to compensate for wear. Thus there is a hardened steel crank pin bearing in the gray iron sliding block, and a hardened steel crank

block gib which bears against the semi-steel rocker arm.

The cross rail is square locked to the column, a type of clamping best suited to resist the direct thrust of the cut. Side alinement is maintained by a taper gib. Felt wipers remove any dust from the face of the column while adjustment is being made. The vertical screw is stationary and made in one piece. The thrust of the revolving nut is taken by a ball bearing. The screw does not project below the floor level.

A heavy steel guard protects the rail bearing from chips. This guard does not in any way decrease the working surface of the table, nor interfere with the operator. The apron is provided with T slots for holding the work when necessary. These T slots do not run across the entire width, but leave reinforcing ribs at the center and sides, thus providing a much stiffer member than would otherwise be the case. A slot is placed across the face of the apron for alinement of fixtures. The apron is secured to the long narrow guide of the cross rail by taper gibs at the top and bottom.

The table is practically a complete box section, having but small openings in the front and bottom. It is secured to the apron by six bolts. The spacing of the T slots is such that the vise will fit either the top or the sides. The table support is of improved design, the sliding action taking place at the bottom of the table instead of at the shaper base. With this type of support, parallel action is not dependent upon the exact alinement of the base. Protection against chips and dirt is complete. The base is made of box section closed at the top and serves to catch oil dripping inside of the column.

New Three-Way Open-Side Planer

THE Cincinnati Planer Company, Cincinnati, Ohio, has just built a special planer which has a bed with two vees and one flat. The box table has five T slots for clamping purposes. The table is also equipped with a table clamp and inner guides to avoid any possible chance for it to lift or tilt out of the track. All ways are provided with forced lubrication which is accomplished by means of a reversible pump that forces the oil into the ways directly under the tool. The oil, before reusing, is settled and strained to avoid dirt from getting into the ways.

The rail is of the extended type and is so constructed as to take care of the strains when cutting at the extreme end. The knee carries the same outline as the rail and is securely bolted and dowelled. Large T-slot blocks, made the full length of the knee bearing, are used for clamping the rail against the column. This insures both a stiff knee and a stiff rail.

The heads are equipped with rapid power traverse in both directions. They have been made exceptionally long so that they can plane some distance below the rail. With this type of head construction the slide can have full bearing on the harp at all times and the down feed screw is always in tension. The rail is equipped with a power elevating device for raising and lowering. A limit stop prevents the rail from being raised beyond its maximum height.

The column is braced and ribbed on the inside in a manner intended to prevent distortion and, in addition to being bolted and dowelled to the bed, a large tongue cast integral with the bed fits a groove in the column, which further provides against moving.

This machine is equipped with a rapid power traverse to the side heads which allows the operator to raise and lower the rail heads by pulling the rapid traverse lever in

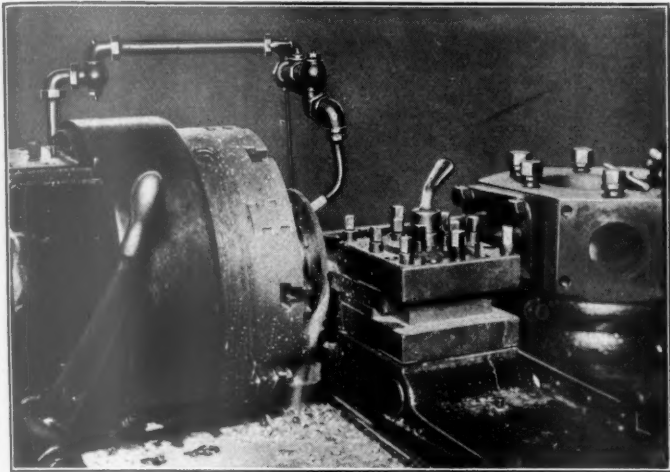
the direction which he wants it to go. The slide is equipped with a hand wheel for feeding, which eliminates the old method of a crank handle which was a source of trouble when reaching to the extreme limit with the slide.



Special Open Side Planer—Cincinnati Planer Company

New Development in Cutting Metal

AN important development in cutting metal has recently been brought out by the Chesterfield Metal Company, Detroit, Mich. This metal is known as Chesterfield cutting metal. It is described as being a non-corrosive, non-ferrous, non-magnetic cast alloy of semi-rare metals. Its composition is such that it cannot be annealed, tempered or



Facing Outside of Side Rod Collar With Cutting Tool of Chesterfield Metal—Speed, 96 R. P. M.; 32 Thread Feed; Depth of Cut, $\frac{1}{8}$ Inch

heat treated in any way that will improve its cutting qualities. The elasticity of the metal is very low. This feature can be more readily appreciated when one considers that its scleroscope hardness is approximately 70, yet it is decidedly harder to file or grind than high speed steel that scleroscopes considerably above this figure. Although the metal is considerably harder than high speed steel, it maintains its cutting edge under the most severe conditions.

Extensive tests run on railroad shop work show that the metal has ample strength to support the tool combined with a degree of toughness which eliminates the breaking and chipping heretofore encountered with cutting alloys. Chesterfield cutting metal can be ground either on a dry or flooded wheel. However, it is not deemed advisable to quench it

in water when hot as the surface may be fractured. In manufacturing, it is cast to shape and, being already hard, it merely requires grinding to be ready for the machine.

A number of tests were made recently in a railroad shop to determine the suitability of this cutting metal for railroad work. There was a saving of 1 min. 50 sec. in facing the back of front side rod collars. From ten to twelve pieces were completed in this operation with Chesterfield metal before it was necessary to grind the tool. Comparative tests using high speed steel showed that it was necessary to grind the tool after performing this operation on from two to three pieces. The time required to make the cut with high speed steel was 3 min. 10 sec., and with Chesterfield metal, 1 min. 20 sec. The depth of the cut varied from $\frac{1}{16}$ in. to $\frac{3}{32}$

Operation on Piston Rings Machine -- 36 in. Bullard Boring Mill Material -- Hunt-Spiller Iron Length of cut, boring and turning 14 in.										
Test No.	Operation	Tool Used	R.P.M.	Cut Ft.	Feed	Cut Depth	Time Min.	Floor to Floor Time		
								High Speed Steel	Chesterfield Metal	Saving
2	Boring and turning	C.M.*	18	95.4 108.7	5/64	3/16 - 1/4	10	142 min.	75 min.	67 min.
	Boring and turning	H.S.S.*	11	58.3 65.4	"	"	18			
	Cut 21 R.	C.M.	25	143.9	.009	3/16 in. wide	35			
	Cut 21 R.	H.S.S.	11	65.4	"	"	112			
	Boring and turning	C.M.	18	99.5 108.7	5/64	1/4	10	160 min.	95 min.	75 min.
	Boring and turning	H.S.S.	11	54.7 65.4	"	"	18			
	Turn 20 1/2 diameter	C.M.	25	143.9	.009	1/2 in. wide	25			
	Turn 20 1/2 diameter	H.S.S.	11	65.4	"	"	90			
* Chesterfield Metal High Speed Steel										

Results of Two Tests on Boring, Turning and Cutting Piston Rings

in. From the outside diameter to the center the cutting speed decreased from 188 ft. per min. to 91 ft. per min.

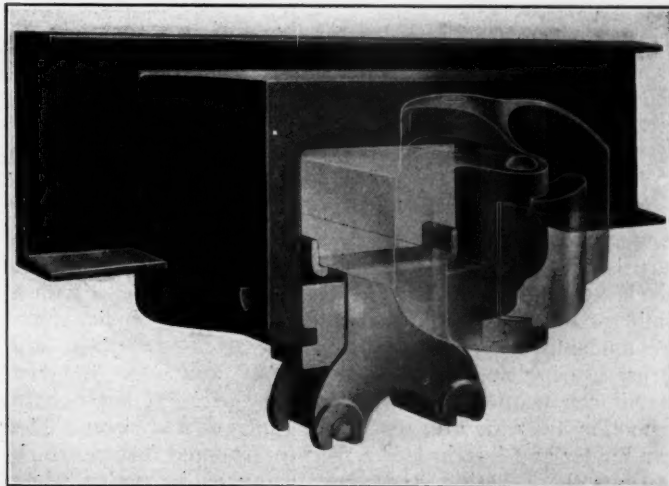
The results of two tests run on a 36-in. boring mill are shown in the table. In the first test a saving of 67 min. was brought about by the increased speed and depth of cut the Chesterfield metal was able to withstand. This saving was considerably bettered in the second test although it was run at practically the same speed and feed as the first test.

A Swing Carry Iron and Centering Device

THE Tuttle Railway Supply Company, Inc., New York, has placed on the market a combination carry iron and centering device that contains several novel features in its construction.

The coupler shank rests on a movable casting supported by swing links from the carry iron. The swing of the links permits the coupler to move to either side of center with little friction. It is always in center position when free on account of the weight of the coupler being supported entirely on the links and swing carry iron.

Aside from the usual results obtained by the use of centering devices, the manner in which the coupler is supported prevents wear on the bottom wall of the coupler shank and the top of the carry iron. The principal wearing points are the bearing surfaces of the swing carry iron and links. No bolts, rivets, pins or cotters are required in its construction. This device is known as the Economy swing carry iron and centering device. The illustration shows its application to the striking plate of a freight car.



Economy Swing Carry Iron and Centering Device

The Master Radial Drilling Machine

THE present development of American-made machine tools in automatic features, power, durability, easy manipulation, wide range of cutting speeds, etc., is a high tribute to the machine tool industry. Its ingenuity in solving problems and persistence in overcoming obstacles have made this development possible.

One of the basic machine tools is the drill, and from a very crude beginning this machine has been improved until it can perform feats undreamed of in former days. The new Master radial drill (Fig. 1), recently placed on the market by the Cincinnati Bickford Tool Company, Cincinnati, Ohio, can drive a 3-in. high speed drill through 55 point carbon steel at 101 r. p. m. and .025 in. feed, or at the remarkable rate of 2.53 in. per min. Besides power this machine has other valuable features which will be referred to later.

The Master radial drill, with a 20-hp. driving motor and a 22-in. column, can be furnished in arm lengths from 6 to 10 ft. It is particularly suited for railroad shop and engine-house drilling operations because of its power and ready adaptability to handle all kinds of drilling jobs commonly encountered in locomotive and car repair work.

The radial arm is made in box section, including the rib-

depth gage and quick return mechanisms. It is entirely encased, reading direct from zero, and is always within convenient reach for positioning. It may be set in an instant to disengage the feed at any predetermined depth, thus guarding against the spindle being advanced beyond its intended range of movement.

The back gears, consisting of six gears and two positive clutches, are incorporated in the head and furnish four changes of speed, each of which transmits more than twice the pulling power of the next faster one. They engage instantly while running and, although fully encased, are readily accessible.

The base is provided with an extension for the table and

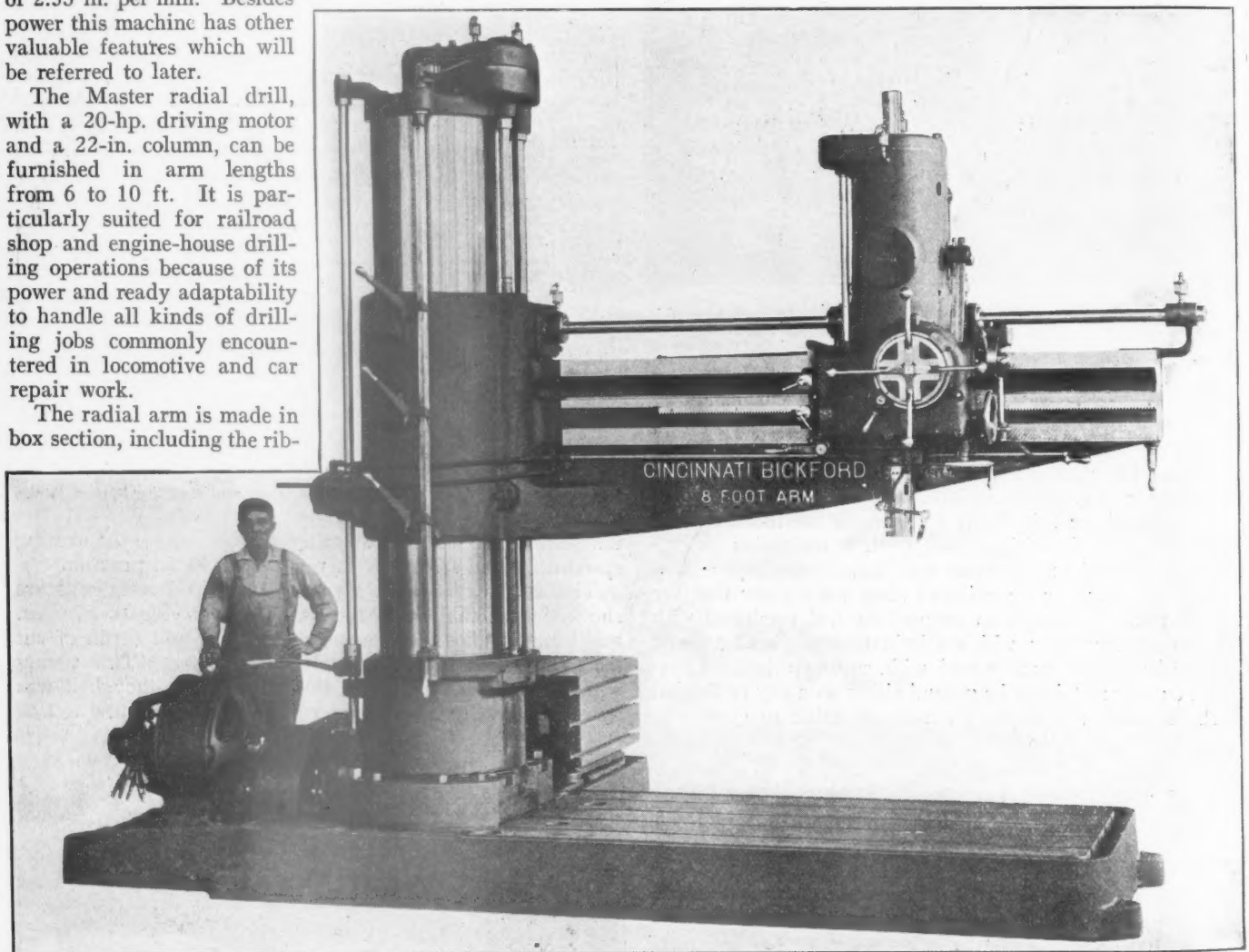


Fig. 1—Cincinnati Bickford "Master" Radial Drill Equipped with Air Column Binder, Cutting Lubricant Outfit and Driven by a 20 Hp. Variable Speed Motor

bing, which gives it great strength. The arm swings with surprising ease considering its weight, and lowers at double its elevating speed. Each of the arm lugs is provided with a limit screw to prevent undue sagging when the binder levers are unclamped. The elevating screw is fitted with a ball thrust bearing and patented safety nut, and is so designed that it can neither be set in motion by accident nor remain in motion after the arm reaches its limits of movement. The arm binder and interlock is a recently patented feature which prevents the elevating screw from being set in motion while the arm is clamped.

An automatic trip is incorporated in the design of the dial

contains a reservoir and channels for the use of a cutting fluid. Being enclosed at the bottom, the base possesses an unusual degree of strength. The bearings are bronze bushed throughout the machine, including those in both the driving and feed mechanisms, and all the more important ones are provided with sight feed oilers of approved design to insure a thorough distribution of oil.

The column consists of two members, an inner trunk made fast to the base, and an outer sleeve which revolves thereon and clamps directly to its enlarged portion. By this means the two become practically one piece when the sleeve is tightened, a construction which not only adds stiffness to the frame

as a whole but greatly enhances the binding facilities. The trunk extends up to and has a bearing at the top of the sleeve. It is internally ribbed in the planes of greatest stress, and is provided with ball bearings to carry the thrust and radial load. The column binder is furnished in three styles, operated by a lever on its cuff, a lever at the end of the arm, or by air from the head. The superior strength of the outer sleeve is used to augment the resistance against spring.

The cutting lubricant outfit not only permits driving drills in steel at a much higher speed than is otherwise possible, but contributes materially to the smoothness of the holes. Its nozzle is attached to the head and consists of a double-

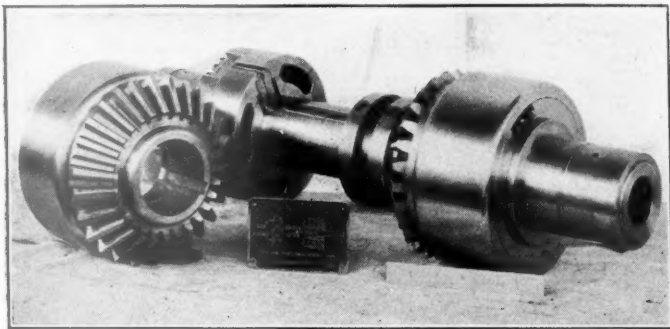


Fig. 2—Driving and Reversing Clutches, Showing Large Friction Rings and Toggle Arrangement for Expansion

jointed pipe connection fitted with a valve which enables the operator to control the stream of fluid from his position at the head.

The drive is furnished in four styles, and may consist of a direct-connected speed box, a constant speed motor and speed box, a variable speed motor mounted on the base as illustrated, or a variable speed motor placed on the arm. The machine is capable of absorbing 28 hp. without overloading the belt.

The feed mechanism advances the spindle at the rates of 8, 10, 12, 14, 16, 20, 25, 30, 35 and 40 thousandths, or .20, .25, .30, .35, .40, .52, .64, .76, .88 and 1.00 millimeters per rev., each of which is instantly available by means of lever-operated drive-keys. The mechanism is entirely encased. It contains two ball bearings to receive the thrust of the worm and is constructed throughout with particular regard to strength. All the operator has to do to obtain any desired feed is to turn the levers to the proper number.

The gearing throughout the driving mechanism is made of nickel steel, hardened and ground, while that in the feed mechanism is proportionately durable. The thrust of the reversing gears is received on ball bearings. No gear exceeds a periphery speed of 960 ft. per min. and each is completely encased.

The head is of exceedingly stiff construction, supports the feed worm gear on either side of its teeth, and is gibbed to an intermediate guide-way, on the principle of a boring machine saddle. On account of its accurate balance, the head can be positioned with great ease. Working parts of the head are few and simple, and, although entirely encased, are readily accessible.

The quick return levers engage the feed the instant they are pulled, thereby eliminating the loss of time incident to having to perform by hand the further operation of engaging a trip-clutch on the worm-shaft before the power-feed becomes effective.

The speed box is provided with a friction clutch and gives, with the quadruple back gears, 24 changes of speed. When driven by a variable speed motor, as many as 60 speed changes are obtainable. The changes are made without shock, and each is positive and instantly obtainable. The speeds are graded to drive 3/4-in. to 3-in. drills at approximately 35, 40, 45, 50, 60, 70, 80, 90 and 100 ft., and to bore

a 10-in. hole at 60 ft. per minute. Although the speed plate (Fig. 3) contains but two columns of figures, it enables the operator to determine at a glance how to position the levers for any of the 144 settings shown.

The spindle is made of high carbon stock, double splined, with a ball thrust bearing both above and below its sleeve. It is provided with a safety stop which trips the feed just prior to the spindle reaching the limit of its movement. The table is furnished in two styles, plain and universal, each of which is made to fit the extension on the base, where it is always ready for instant use.

The tapping mechanism drives through friction clutches and hence permits the operator to start, stop and reverse the spindle without shock while the rest of the machine is running. It is operated from the front of the head and its advantageous position between the arm shaft and back gears, which minimizes the duty required of the frictions, enables it to transmit at its lowest speed power far in excess of requirements.

For purposes of comparison the Cincinnati Bickford Company has made a complete test of the power absorbed by Master radials in driving drills at various feeds in medium

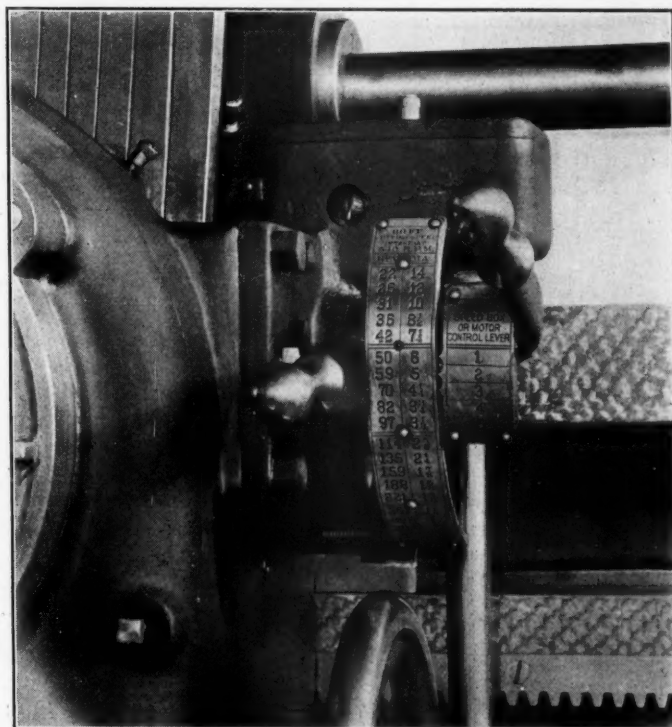


Fig. 3—View Showing Back Gear Levers and the Direct Reading Speed Plates

hard steel. Selected test results, one for each size of drill, are shown in the accompanying table. The large drills are operated at a lower peripheral speed than the small ones because they cannot be kept cool under a fixed size stream of cutting lubricant.

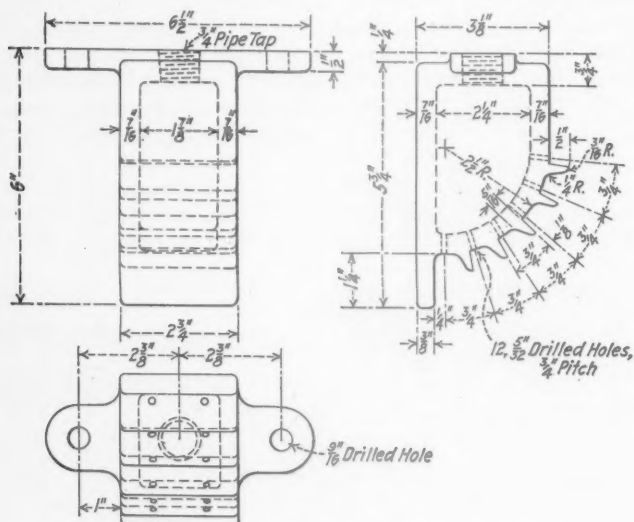
POWER ABSORBED BY MASTER RADIALS IN DRILLING MEDIUM HARD STEEL
(When Fitted with a Variable Speed Motor Mounted on the Base)

Dia. of Drill	Speed		.012 Feed		.016 Feed		.020 Feed	
	Rev.	Feet	Depth	Power	Depth	Power	Depth	Power
3/4	510.0	100.2	6.12	5.40	8.16	6.69	10.20	7.88
1	373.0	97.6	4.48	5.61	5.97	6.94	7.46	8.18
1 1/4	294.5	96.4	3.54	5.80	4.72	7.18	5.89	8.48
1 1/2	251.7	98.9	3.02	6.22	4.03	7.70	5.03	9.09
1 3/4	207.2	95.0	2.49	8.07	3.32	9.99	4.15	11.78
2	177.0	92.7	2.12	8.09	2.83	10.01	3.54	11.81
2 1/4	151.2	89.6	1.82	7.88	2.42	9.76	3.03	11.50
2 1/2	139.8	91.5	1.68	8.32	2.24	10.30	2.80	12.15
2 3/4	119.5	86.1	1.43	7.83	1.91	9.69	2.39	11.43
3	110.5	86.8	1.33	8.04	1.77	9.95	2.21	11.74

Ash Pan Sprinkler and Cleaner

THE Pratte Vacuum Air Sander Company, Denver, Col., has on the market an ash pan sprinkler and cleaner of unique design. Water is piped through a 1-in. pipe from the injector pipe to a number of sprinklers located at strategic points at the center and sides of the ash pan. The water is turned into the supply pipes by a valve in the cab. As shown in the illustration, the sprinkler is designed to spray the water over a large area. The number of sprinklers required depends upon the size of the ash pan.

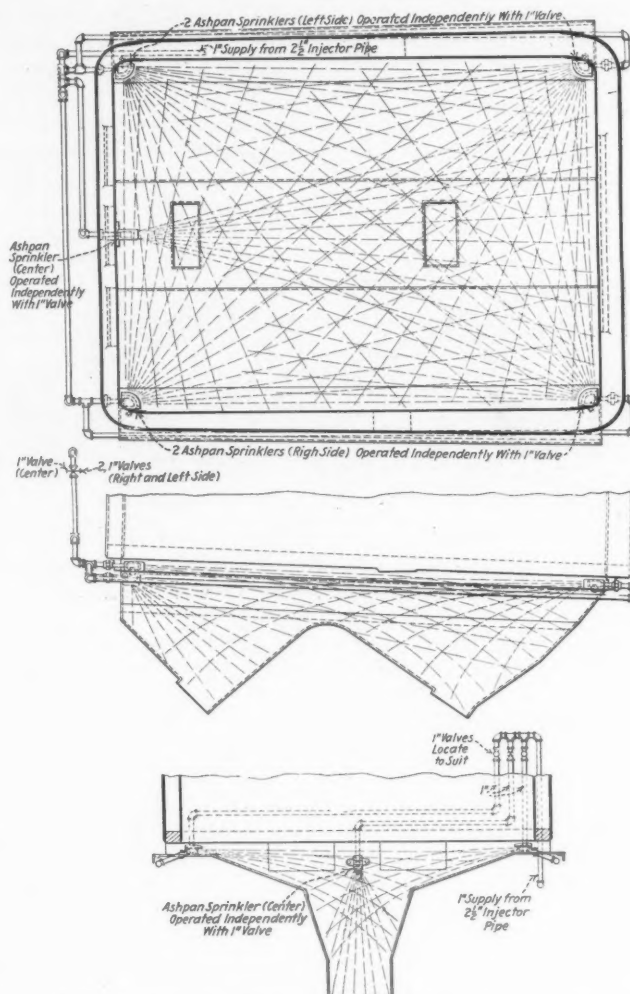
considerable saving is accomplished as the pan will not warp when this device is used.



Drawing of Sprinkler Nozzle for Side of Ashpan

On a pan of 11 ft. or more it is recommended that a sprinkler be placed at each corner.

With boiler pressure behind the stream, any fire shaken through the grates can readily be put out and the ash pan given a thorough cleaning. It is claimed that where this device is installed on locomotives, cleaning the ash pans with a hose at terminals is practically eliminated. A better draft through the grates is obtained with a clean ash pan and



Arrangement of Sprinkler on an Ashpan of Large Size

Oil-Burning Rivet Forges and Torches

A LINE of modern rivet forges with non-clogging vacuum oil burners, oil-burning torches, and pressure blowers has been developed and recently placed on the market by the Johnston Manufacturing Company, Minneapolis, Minn. The rivet forge, shown in one of the illustrations, is made in three styles, No. 1 for car repair yards, No. 2 for structural steel shops and No. 3 for boiler shops. The only difference in these forges is in the capacity of the burners, the No. 3 forge having about one-fourth the capacity of the burner on the No. 1. All the burners are adjustable through the usual range of about one to three, but best results are obtained by having the burner on each forge adapted to its specific use.

Aside from strength and easy portability by means of the large-diameter, ball-bearing wheels with wide tires, the principal feature of this rivet forge is the non-clogging vacuum oil burner, shown separately in one of the illustrations. In order to avoid the formation of scale on rivets a uniform flame is necessary, obtainable only by maintaining the oil feed in proper proportion to the air. To accomplish this result the Johnston oil burner was developed with an air inlet valve by which the oil feed is regulated indirectly. This air

valve does not clog since only air passes through it and as the air passages in the burner are larger and direct, the oil flow tends to remain uniform, and the character of the gases in the heating chamber consequently remains as first adjusted.

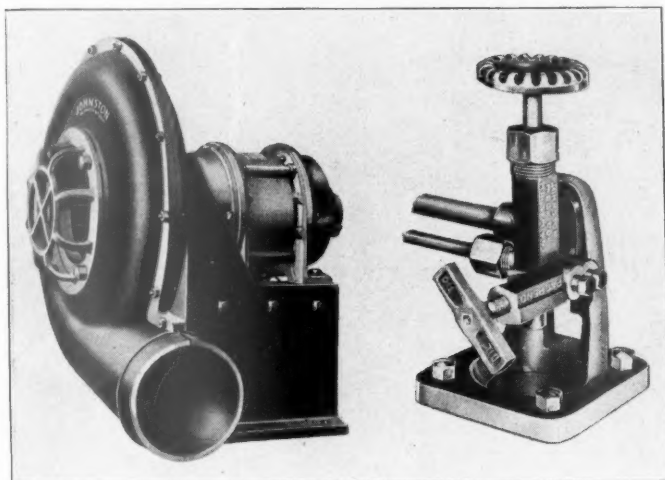
To overcome difficulty from variable air pressure in shops, and especially in car repair yards, this burner was so designed that the vacuum by which the oil is drawn up varies directly as the air pressure. The relation between the air and oil supply are, therefore, automatically maintained as first adjusted regardless of changes in air pressure. As a result of the non-clogging feature and provision to offset variable air pressure the character of the flame remains constant; scaling and smoking are reduced to a minimum and the forge operates at high combustion efficiency. The burner has a high vacuum and large oil connections, enabling heavy oil to be used.

The frame of this forge is in the form of a triangle, providing maximum strength and rigidity in proportion to weight. This is a valuable feature, in view of the use and abuse to which rivet forges are put in the course of everyday service.

Forge linings often fail by burning through at the top where the flame strikes and by cracking and spalling around the charging opening. In the Johnston forge the linings are not less than $4\frac{1}{2}$ in. thick where the flames strike and with a charging opening 6 in. wide there is little tendency for this opening to become enlarged by cracking. Additional features are the pivoted tongue which acts as a guard for the burner, the filling funnel and strainer, the air curtain pipe to deflect the hot gases upward and the welded oil tank which has a capacity to hold 20 gallons of fuel oil.

Oil Burning Torches

The oil-burning torch illustrated is made in two styles, No. 20 for car repair work and No. 21 for firing locomotives



Pressure Blower for Furnaces and Forges—Vacuum Oil Burner

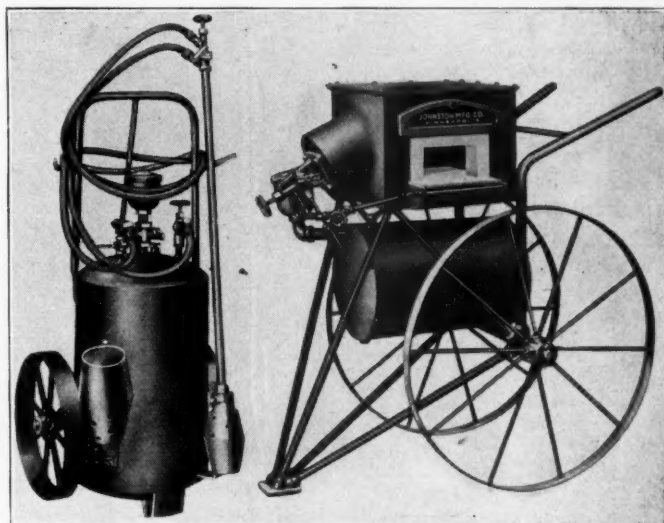
for steam test or for starting coal fires in locomotives. The difference between the two styles is in the capacity of the atomizer, the first using 15 gals. of oil an hour and the second 35. This torch, known as the "one man portable," is featured by high capacity and light weight combined with rugged design. This is accomplished by using light, practically unbreakable cast steel nozzles and one large pipe from the torch head to the hose connection. This single pipe is strong and easy to hold. Instantaneous ignition and steady operation are accomplished by a new and unique atomizer which breaks the oil up into a fine fog close to the torch head and permits the use of a short, and therefore light, single chamber nozzle. Pressure in the oil tank is blown down through the air connection, and this operation does not spray oil over the operator. The filling funnel has a strainer in which the dirt collects and is effectually prevented from entering the tank. Plug cocks are used on air and filling connections for quick and easy operation. The oil hose is protected by an automatic valve which closes in case of failure of the oil hose.

This torch has an unusual range of capacity with either nozzle. The large nozzle operates from a small flame 12 in. long up to the big flame required for firing a locomotive

boiler for the steam test. Another feature is the tubular handle for the tank, providing a light, convenient grip. The length of hose furnished is $12\frac{1}{2}$ ft. As in the case of the rivet forge the oil tank is welded. It has a capacity of 20 gallons. An extra nozzle for the torch is carried on a bracket as shown in the illustration, being always available. The nozzles run at moderate temperatures, giving long life.

Pressure Blowers for Furnaces and Forges

An ample supply of air at the full rated air pressure is imperative for the satisfactory operation of oil burners. To provide this air pressure when not otherwise available, the Johnston Manufacturing Company has developed the special pressure blower for oil-burning furnaces and large coal forges illustrated. This blower is designed to maintain a practically constant pressure from no load to full load of 10 oz. per sq. in. There are no moving parts except the blower wheel and the rotor of the motor and no bearings except the motor bearings, which are lightly loaded. These considerations and the fact that the blowers are especially designed for use at the standard speed of the 60-cycle alternating current motors by which they are driven tends to give high efficiency. The rigid construction of the motor base and direct connection between motor and lower casing assure permanent alinement. The power input is about 20 per cent of full load at no discharge and increases uniformly to full



Oil-Burning Torch and Rivet Forge for Car Repair and Boiler Shops

load at full discharge. This gives economical operation when only a small amount of air is required. The blowers may be equipped with direct current motors of the same speed as the corresponding alternating current motors.

This blower is made in four sizes with the following motor rating and output: two horsepower, 500 cu. ft. per min.; three horsepower, 800 cu. ft. per minute; five horsepower, 1,250 cu. ft. per minute; seven and one-half horsepower, 1,800 cu. ft. per minute.

Developments In Aluminothermic Welding

CONSIDERABLE advancement has lately taken place in aluminothermic welding, due to the fact that the design of the mold, the class of molding material used, and proper venting of the mold have been the subjects of study and improvement. It was at one time claimed that ordinary cast steel foundry practice could not be followed because of the excessive temperature at which aluminothermic steel was handled. It is now recognized that the best aluminothermic steel can be injured by pouring in a mold where no

precaution has been taken to prevent the generation of gases from unsuitable molding material or organic binders when subjected to the intense heat. The gases, under pressure, are absorbed by the metal. This results in a poor weld due to blow holes and spongy metal. Even with suitable molding material, care should be taken to thoroughly vent the mold as is the practice in steel foundries.

The preparation of the parts to be welded is extremely important in all classes of welding. If precautions are not

taken to relieve strains, the members are apt to fracture in service outside the welded area, although the weld itself may be good. In heavy welding where the aluminothermic process is used, it is claimed that metal of exacting specifications can be introduced in bulk in a reducing condition between the parts to be welded with better results than by the drop by drop production of metal used in both electric and autogenous welding. Oxidation is unavoidable and slag inclusions as well as internal strains set up as each successive layer of metal is added. There is only one strain where bulk metal is available, and this can be taken care of in a definite manner. In smaller sections the strains do not have so much effect as they are relieved by warping of the parts. It is said that the aluminothermic process does not depend to a great extent on the skill of the operator and there is small chance of failure if instructions are followed.

Until recently, the drawback to a more extensive applica-

tion of the aluminothermic process was its high cost and lack of uniform metal. The inventor of the process, the late Dr. Hans Goldschmidt, developed a method of producing an aluminothermic mixture that produces metal of uniform character. His researches resulted in the mixture marketed under the trade name Feralite, by the Alumino-Thermic Corporation, Roselle Park, N. J., being produced at a considerably lower cost. No metallurgist endeavors to produce steel without a thorough understanding and control of the slag. Until Dr. Goldschmidt's recent investigations and discoveries, this angle of the aluminothermic generation of steel, it is said, had apparently not been investigated.

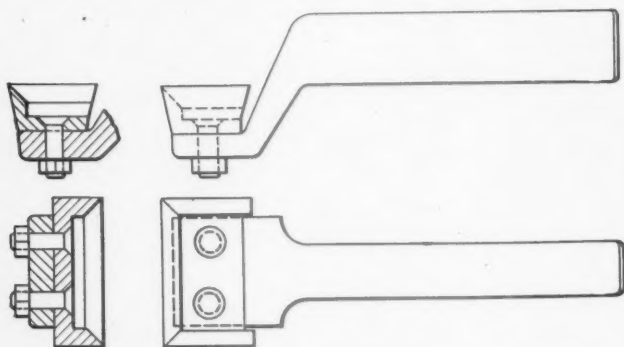
In Feralite, the ingredients are treated and then compounded in such a manner as to obtain proper fluidity of slag to prevent absorption by the metal of the gases and impurities. This is claimed to insure metal of uniform analysis and physical characteristics.

Planer Tool for Removing Babbitt

A TOOL to be used on metal planing machines for the purpose of removing babbitt or soft metal from a locomotive crosshead shoe has been patented by H. H. Henson, machine shop foreman of the Southern, Chattanooga, Tenn. The object in designing this device was to save time and to insure the thorough removal of all loose babbitt or soft metal. This is essential in order to prevent the loosening of the replaced metal after the shoe has been relined. A further purpose of the invention is to provide a planer tool which will obviate digging or hanging in the metal, eliminate chatter and the formation of marks presenting an unfinished appearance which, in operation, rolls or bunches the metal. It will be noted in the illustration that the soft metal is removed in long shavings, which can readily

cutter is secured to the holder by means of two countersunk bolts as shown in the drawing.

It is claimed that this tool is rapid and effective in operation and insures the thorough removal of all this metal from



Drawing Showing Detail Construction of Planer Tool

be kept separate from other metal cuttings and chips. This simplifies the reclamation of the soft metal for further use.

The tool is comprised of a holder and a cutter. The holder is a forging or piece of machine steel heavy enough to support the cutter without chatter, or to give it a tendency to dig or hang in the babbitt metal. It is comprised of a shank, a seat and an offset whereby the seat is disposed laterally from the line of the shank and at such a distance as to bring the cutting edge of the cutter in line with the center line of the fulcrum of the tool.

The cutter consists of a base, and end bit and side bits. The bits are preferably formed separately and electrically welded to the base and to one another. They have a rake of about 45 deg. and a clearance approximating 90 deg. It is best made of carbon tool steel and is tempered to a degree to permit the bit being sharpened by a fine mill file. The

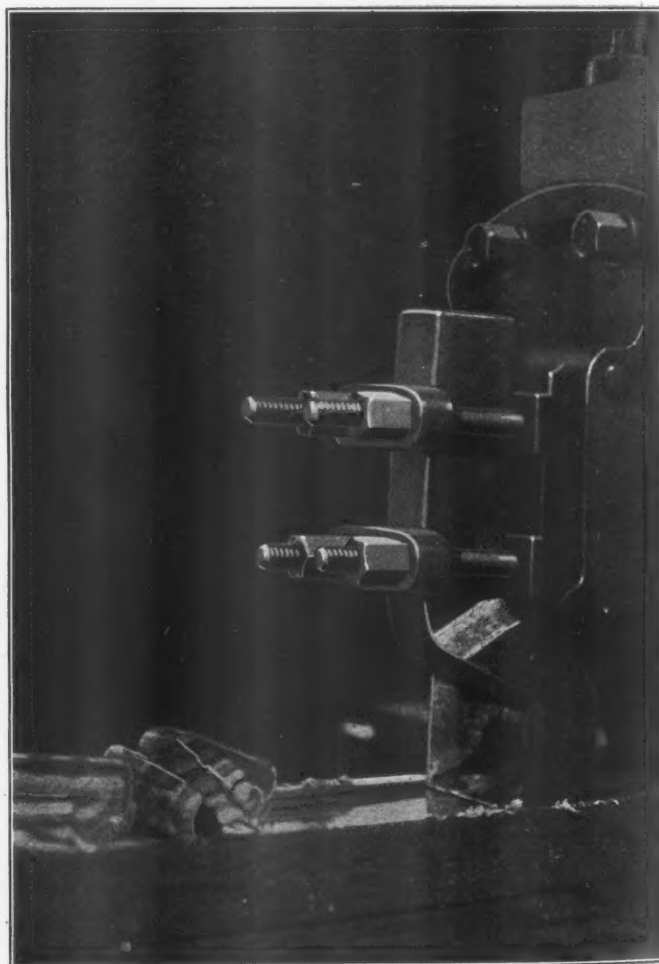


Illustration Showing the Manner in Which Planer Tool Removes Babbitt

the crosshead shoe, and is free from chatter or any tendency to produce marks which would give an unfinished appearance. This tool is to be placed on the market by the Adams-Fisher Manufacturing Company, St. Louis, Mo.

GENERAL NEWS

The Japanese Department of Railways reports that 386 passenger cars were lost in Tokio alone, together with 33 locomotives and 31 electric cars. Only a few of locomotives can be re-conditioned for service.

The Pere Marquette has extended its group insurance plan entered into with the Equitable Life Insurance Society on July 1, 1922, to cover all employees of the mechanical department. The employees will pay one-half of the premium and the company will pay the balance.

The Interstate Commerce Commission has reopened its investigation into the cost of construction and repair of railway equipment in so far as it pertains to locomotives on the Erie. This is the proceeding in which the commission criticised certain railroads for the amount of the expenditures for repairs to locomotives in outside shops during 1920.

Following closely on the announcement of the Mechanical division of the American Railway Association that it will hold its annual convention at Atlantic City on June 11-18, 1924, the Pennsylvania System has announced that it will operate a special train in two sections from Chicago to Atlantic City, leaving Chicago at 1 p. m., Monday, June 9, and arriving at Atlantic City at 10:30 the following morning, making intermediate stops at Englewood (Chicago), Fort Wayne, Ind.; Lima, Ohio; Crestline, Alliance and Pittsburgh, Pa. These trains, each of which will consist of ten cars, will contain the same equipment as the Broadway Limited.

Employees of the Altoona shops of the Pennsylvania numbering 15,000, through elected representatives, have passed a resolution addressed to the Interstate Commerce Commission protesting against any attempt on the part of the officials of the state of Pennsylvania or any other state in recommending any reduction in freight or passenger rates at this time to increase the miners' wages. This resolution was occasioned by the suggestion of a decrease in freight rates in order to absorb the 10 per cent increase in wages granted the anthracite miners under Gov. Pinchot's settlement plan. The railroad men fear that a loss in railroad income would ultimately be met by reduction in their wages.

The Railroad Labor Board announces that notice has been received from the New York Central and from the road's shopmen withdrawing from the Board their controversy as to wages; indicating that an agreement has been reached between the company and its employees for the use of the piece-work system of payment. The classes of workers affected are the machinists, boiler-makers, blacksmiths, sheet metal workers, electrical workers, carmen, helpers and apprentices and car cleaners. It is understood that for the present the piece-work system will not apply to wrecking service, road service, power-house employees, millwright gangs, or car inspecting and repairing in train yards. Piece-work prices are to be increased or reduced corresponding with changes in the hourly rates.

Rolling-Stock Construction Increases in Poland

A total of 140 passenger and 1,910 freight cars were built in Poland in 1922, compared with 20 passenger and 400 freight cars built in 1921, according to the acting commercial attaché at Warsaw. Of the locomotives constructed during 1922, 10 were built at the locomotive works at Chrzanow. Polish locomotive and car building companies have on hand orders for 2,600 locomotives, 7,800 passenger, and 70,400 freight cars.

Fuel Association Competition Prize Awarded

The prize of \$100 offered by Eugene McAuliffe through the International Railway Fuel Association for the best paper on fuel conservation by an engineman, fireman, conductor, brakeman or switchman has been awarded by the judges to W. L. Richards, locomotive engineman employed by the Union Pacific at North

Platte, Neb. The competition, which closed August 31, aroused wide interest and 2,028 papers were received by the association. The volume of work entailed in classifying and reading these papers was so great that a prompt announcement of the result was impossible.

In addition to the association prize of \$100, Mr. Richards also receives the Railway Age prize of \$50 for the best paper submitted in the contest, the Union Pacific prize of \$100 for the best local paper and one of the Railway Review prizes of \$10 for the winner of each local contest.

Safety Appliance Act—Defective Couplers

The Texas Court of Civil Appeals holds that a railroad cannot, by a rule relieving switchmen of going between the cars, when, because of its failure to comply with the Safety Appliance Act, the switchmen could not uncouple the cars without going between them, exempt itself from liability under Section 2 of the act, requiring automatic couplers.—St. Louis Southwestern v. Hosey (Tex. Civ. App.), 247 S. W. 327.

Inspection Bureau Finds Defective 55 Per Cent of Locomotives Examined

The Interstate Commerce Commission's monthly report to the President on condition of railroad equipment shows that during October 6,507 locomotives were inspected by the Bureau of Locomotive Inspection and 55 per cent were found defective, while 525 were ordered out of service; also, 103,827 freight cars were inspected, of which 4.7 per cent were found defective, and 2,300 passenger cars, of which 1½ per cent were found defective.

Anthracite Shipments in October

Shipments of anthracite for the month of October, as reported to the Anthracite Bureau of Information, Philadelphia, amounted to 6,564,526 gross tons. These figures are not comparable with the previous month of September on account of the suspension of mining during negotiations between operators and miners. The average daily shipment in September after operation was resumed amounted to 219,490 gross tons, while the average daily shipment during the month of October amounted to 262,581 tons, an increase of about 43,000 tons.

Slack Work in Railroad Shops

The Pennsylvania Railroad furloughed several thousand shopmen on November 26; and according to newspaper accounts, this general suspension of work will continue until December 3. A memorandum was issued by the company stating that the readjustment of forces was coincident with the usual normal slackening of freight traffic at this season and that the company's supply of serviceable freight cars and locomotives was now ample for all needs.

The Baltimore & Ohio on November 26 closed its principal shops for one week, laying off several thousand men.

The New York, New Haven & Hartford has laid off about 1,000 shopmen, furloughs being ordered at Readville, New Haven, East Hartford, Providence, Norwood and Van Nest.

Motor Trains Increasing in France

The use of internal-combustion motors for trains appears to be developing rapidly in France. The State Railway, it is announced, has recently placed an order for 10 units on the model of the one tried out successfully between Mortagne and St. Gauberge, the motor being applied to an ordinary passenger coach. The Renault firm is also actively engaged in perfecting a new type of motor train called the Scemia-Renault, which was run on trial recently

over the lines of a local Rheims company. This car carries 40 passengers and is equipped with double-end controls, whereby the necessity of a turntable is avoided. On the 350-mile stretch between Rheims and Asfeld, with 2.5 to 2.8 per cent grades, the average gasoline consumption was 108 gallons per 1,000 miles and the average speed 25 miles per hour. With a trailer, the consumption would be 138 gallons. It is stated that orders for six cars have been received and that the Societe des Transports en Commun de la Région Parisienne, which controls all the surface traffic in and around Paris, intends to place one of them in regular service on the Versailles-Les Mureaux line.

October Locomotive Shipments

The Department of Commerce has prepared the following table showing shipments of locomotives in October from the principal manufacturing plants, based on reports received from the individual establishments:

	LOCOMOTIVES			Ten months' total, January to October	
	October 1923	September 1923	October 1922	1923	1922
Shipments—					
Domestic	295	313	133	2,410	718
Foreign	15	22	12	151	187
Total	310	335	145	2,561	905
Unfilled Orders— (End of month)					
Domestic	915	1,102	1,420
Foreign	62	76	118
Total	977	1,178	1,538

Labor Board Decisions

In a dispute between the maintenance of way employees of the Norfolk & Western and the management in regard to the application of the overtime rule when the meal period is worked, the Labor Board has ordered that the payment of time and one-half starts at the expiration of the tenth continuous hour on duty, computed from the employees' regular starting time. It further ordered that where this continued service includes meal period, no deduction shall be made therefor, and the employee shall, at the first opportunity, be allowed 20 minutes in which to eat.—*Decision No. 2015.*

The Labor Board, in reconsidering Decision No. 1726 in which it ordered that supervisors of mechanics on the Denver & Rio Grande Western, who had been considered out of service on account of their refusal to exercise their seniority as mechanics, be reinstated, has decided that evidence introduced in the rehearing was such that the request for reinstatement of the supervisors of mechanics should be refused, upholding the contention of the road.—*Decision No. 2006.*

Wage Increases

The Missouri-Kansas-Texas has increased the wages of shopmen 2 cents an hour, effective October 14. The increase will aggregate \$226,000 annually and affects workers in all mechanical crafts.

Shop crafts employees on the Atlantic Coast Line have been granted wage increases, effective October 15, which will aggregate \$400,000 a year. Mechanics receive an increase of 3 cents an hour, apprentices, 2 cents an hour, and helpers, 1 cent.

Stationary engineers and firemen and shop laborers on the Northern Pacific have been granted wage increases of about 1 cent an hour. Clerks, freight handlers, express and station employees on the Staten Island rapid transit have received wage increases of from 1 to 2½ cents an hour.

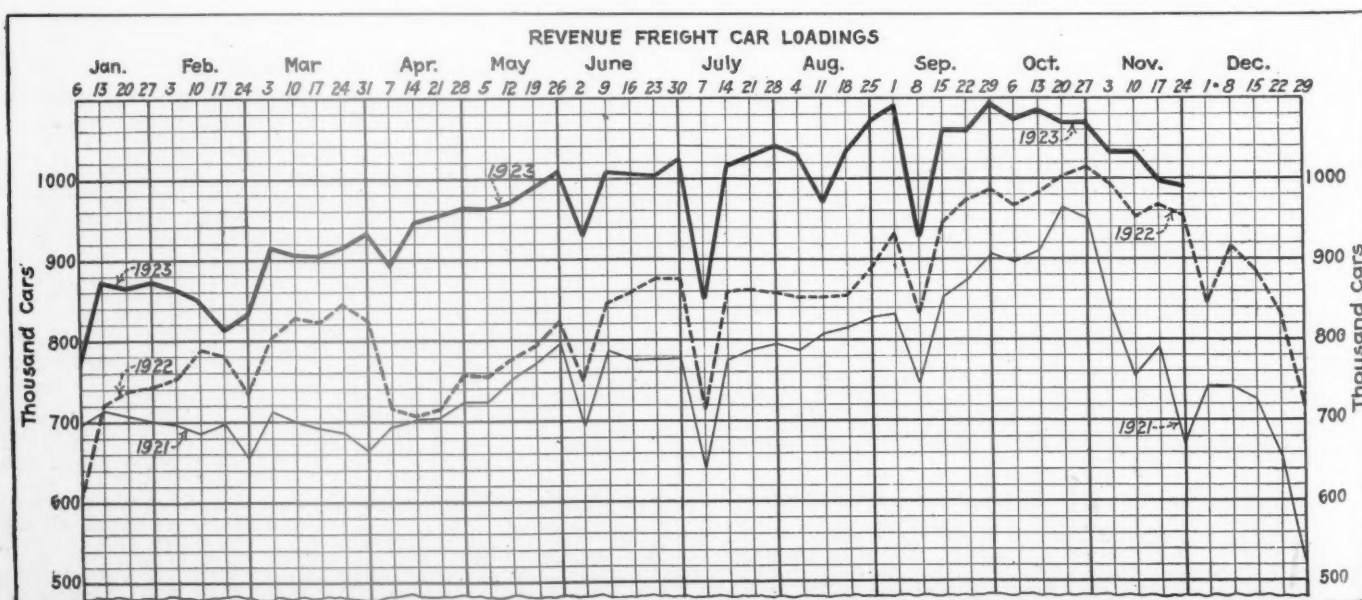
Shopcrafts employees of the Chicago, Burlington & Quincy have been granted an increase in wages of 2 cents an hour; following a series of conferences between officers of the road and representatives of the shop workers. The increase will affect some 18,000 men of all classes in the shops and will add approximately \$1,000,000 per year to the payroll of the road.

Rock Island Stock for Employees

The Chicago, Rock Island & Pacific has put into effect a plan whereby employees may secure preferred stock on a monthly payment basis. Any employee of the company of more than six months' service may invest in the preferred stock of the railway under this plan. Both 7 per cent and 6 per cent preferred stock may be bought but the total which may be ordered or carried at any one time must not exceed one share for each \$300 of annual salary or pension of the employee and shall not exceed ten shares altogether.

The amount to be paid for the stock will be governed by the market price at the time it is purchased. Active employees of six months' service or more will be required to make an initial payment of \$5 a share and a monthly payment thereafter of not less than \$3 a share. Pensioned employees are permitted to buy, and they are not required to make the initial payment of \$5 a share. Ten per cent of the purchase price will be deducted from each monthly pension check.

The company will hold the stock purchased as security for the payments of the balance of the purchase price, which balance will be paid through payroll deductions as authorized by the employee. Interest at the rate of six per cent per annum will be assessed on the unpaid balance, and dividends received on the stock will be applied to the unpaid balance. The employee may make full payment at any time but contracts of purchase are not transferable. An employee may terminate the contract at any time, when the stock will be sold at the current market price.



Comparison of Revenue Freight Car Loadings for 1923 with 1922 and 1921

Oklahoma Commission Approves Railways' Physical Condition

Efforts of shopcrafts employees on several lines in Oklahoma to secure the appointment of inspectors to investigate and report on the physical condition of the roads in the southwest territory proved unsuccessful when the Oklahoma Corporation Commission declared that no necessity exists for such appointments and that the complaint was obviously based on misinformation. The submission which was brought against the roads by the defeated shopcrafts strikers was presented to the Oklahoma commission on August 6 by O. E. Heath, an officer of the railway employees' department of the American Federation of Labor. The Chicago, Rock Island & Pacific and the Arkansas Western were particularly charged with "employing in the transportation of passengers and freight, engines and cars with such defects as to imperil the safety of passengers and employees." The Oklahoma commission found "that the motive power and rolling stock of the railroads in Oklahoma are at this time in as good if not better condition than at any period in the history of the railroads." The report of the commission also pointed out that freight traffic had been expedited in 1923, that the cars furnished had been in excellent condition, that claims for loss, damage and delay had been much decreased and that shippers in Oklahoma had not suffered from any car shortage.

Hal S. Ray Addresses Chicago Car Foremen

The Car Foremen's Association of Chicago held its regular monthly meeting Monday evening, November 13, at the Great Northern Hotel, Chicago, the principal address, which was in the nature of an inspirational talk, being by Hal S. Ray, director of public and personnel relations of the Chicago, Rock Island & Pacific. Mr. Ray, after commenting briefly on railroad public relations work, devoted his attention to the railroad foreman and his responsibility in interpreting management ideals and policies to his men. Regarding this subject, Mr. Ray said in substance: "Railroad officers are honest in advocating the square deal to their employees. They are honest, if for no other reason, because it is the best policy. The day of 'bunk' and 'bluff' in railroading has long since passed, experience having repeatedly demonstrated that the only way to secure results with men is by treating them fairly. It is the duty of foremen to overcome the suspicion with which employees from long habit regard all improvement and betterment plans emanating from the management.

"The rank and file of railroad foremen do not realize the importance of their jobs and the big opportunity which they have to be of inestimable service by creating a better understanding between the managements and the men. Foremen are the channels through which right can be made wrong, and wrong can be made right. The best plans developed by the managements can be made non-effective by the way in which they are interpreted to the workmen, and on the other hand, workmen will be slow to think ill of any railroad which is fortunate in employing able, conscientious foremen. Most railroad foremen are always on the job, efficient, dependable, but entirely too modest and unassuming, with the result that the importance of their work is not always appreciated. It is the foreman's duty to be consistently hopeful and helpful in dealing with his men, always endeavoring as far as may be possible to give each man work to which he is fitted and which he can enjoy. No part of the foreman's work is more important than to encourage and help the men who work under him. When questions are asked regarding various phases of the work, courteous, brief and informative answers should be given. Don't answer a question with a lot of conversation which doesn't mean anything. Another essential is to convey to workmen an understanding of the importance of their work and an appreciation of the vital link which they form in the railroad chain."

271 Swedish Locomotives Received in Russia

Of the 500 railroad locomotives of the 0-10-0 type ordered by Russia from the Swedish firm Nydquist & Holm in 1921, 271 have been passed by the Russian inspecting commission up to September 1, and 55 more were expected to arrive before the close of the present navigation season, according to an abstract from Economic Life (Moscow) appearing in Commerce Reports.

The new locomotives have already been placed in operation on the Northern, the Murmansk, the Moscow-Kazan, the Kiev-

Voronezh, the Southern, the Syzran-Viazma, and the Transcaucasian Railways.

B. & M. Contemplating Group Insurance

Group insurance for employees of the Boston & Maine is being planned for, with the expectation of giving the benefits of the scheme to about 6,500 employees. This action has been taken at the request of the Mechanical Employees' Association. It is proposed to provide policies of \$1,000 life insurance each, with certain weekly payments for sick or accident disability. As in other movements of this kind, at least 75 per cent of the employees in each class must accept the scheme before it can be made effective. The railroad company will, it is understood, contribute to the insurance the minimum proportion required under the insurance company's terms.

MEETINGS AND CONVENTIONS

Mechanical Convention at Atlantic City

The General Committee of Division V, Mechanical, of the American Railway Association, at its meeting in New York on Thursday, November 8, decided to hold a convention, with exhibits, at Atlantic City on June 11-18, 1924. The Executive Committee of the Railway Supply Manufacturers' Association also voted on the same day in New York to hold an exhibit on the same dates, viz., June 11-18, 1924.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

- AIR-BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City.
- AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—C. Borchardt, 202 North Hamlin Ave., Chicago.
- AMERICAN RAILWAY ASSOCIATION, DIVISION V.—MECHANICAL. V. R. Hawthorne, 431 South Dearborn St., Chicago.
- DIVISION V.—EQUIPMENT PAINTING DIVISION.—V. R. Hawthorne, Chicago.
- DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St., New York.
- AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—W. C. Stephenson, Atlantic Coast Line, Rocky Mount, N. C.
- AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, A. F. Stuebing, 23 W. Forty-third St., New York. Annual meeting December 3 to 6.
- AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eismann, 4600 Prospect Ave., Cleveland, Ohio.
- AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.
- ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.
- CANADIAN RAILWAY CLUB.—W. A. Booth, 53 Rushbrook St., Montreal, Que. Next meeting December 11. Paper on Handling of Mail by Railways will be presented by R. L. Laprairie, inspector railway mail service, Montreal. Stereopticon views.
- CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.
- CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—Thomas B. Koenke, 605 Federal Reserve Bank Building, St. Louis, Mo. Meetings, first Tuesday in month at the American Hotel Annex, St. Louis.
- CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Cortlandt St., New York, N. Y.
- CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—W. P. Elliott, T. R. R. A. of St. Louis, East St. Louis, Ill.
- CINCINNATI RAILWAY CLUB.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings second Tuesday, February, May, September and November. Next meeting November 13, annual dinner and election of officers.
- INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich.
- INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. B. Hutchison, 6000 Michigan Ave., Chicago, Ill.
- INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabash St., Winona, Minn.
- MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 26 Cortlandt St., New York, N. Y.
- NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Next meeting December 11, Copley-Plaza Hotel, Boston. Paper on Air Brake will be presented by George Terwilliger, general air brake inspector, N. Y., N. H. & H.
- NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Cortlandt St., New York. Meeting third Friday of each month except June, July and August at 29 West Thirty-ninth St., New York. Annual dinner December 6, Hotel Commodore, New York, N. Y.
- NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y.
- PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Next meeting December 13. Seventh annual holiday entertainment for families of members.
- RAILWAY CLUB OF GREENVILLE.—G. Charles Hoey, Plum St., Greenville, Pa. Meetings last Friday of each month, except June, July and August.
- RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meetings fourth Thursday in month, except June, July and August, Fort Pitt Hotel, Pittsburgh.
- ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, Union Station, St. Louis, Mo. Next meeting December 14. Paper will be presented by N. D. Ballentine, assistant to president, Seaboard Air Line.
- TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio.
- WESTERN RAILWAY CLUB.—Bruce V. Crandall, 605 North Michigan Ave., Chicago. Meetings third Monday in each month, except June, July and August.

SUPPLY TRADE NOTES

James J. Dale has resigned as vice-president and director of the Consolidated Machine Tool Corporation, New York.

The Crane Company will construct a two-story foundry, 160 by 500 ft. in area, at 4100 South Kedzie avenue, Chicago.

The Stafford Roller Bearing Car Truck Corporation, Lawton, Mich., has been placed in receivership. Justus S. Stearns has been appointed receiver.

The American Car & Foundry Company has ordered the structural steel for a foundry at Madison, Ill., from the Kenwood Bridge Company.

Harry R. Rochester, western sales manager of the Hale & Kilburn Corp., with headquarters at Chicago, died October 28 at Atlantic City, N. J.

The Cleveland sales office of the Jones & Laughlin Steel Corporation has been moved from 1314 Rockefeller building to 1407-11 Union Trust building.

H. B. Thurston, sales manager of the Talmadge Manufacturing Company, Cleveland, Ohio, was on November 23 elected vice-president of the company.

C. A. Dunn, formerly sales manager of The Weldless Tube Company, has been appointed manager of the Delaware Seamless Tube Company, Auburn, Pa.

The American Brake Shoe & Foundry Company has ordered the structural steel for a foundry building at Kansas City, Mo., from the Kansas City Structural Steel Company.

Jay C. Lathrop, representative of the Conveyors Corporation of America, Chicago, Ill., in the Cincinnati district, has removed his office to 503 Neave building, Cincinnati, Ohio.

The Morrison & Risman Company, Buffalo, N. Y., dealer in railway equipment, has opened a district sales office in the Ulmer building, Cleveland, Ohio, in charge of R. B. Morrison.

The Philadelphia division of the B. F. Sturtevant Company, Boston, Mass., is now located at Thorne & Copewood streets (near White Horse pike and Haddon avenue), Camden, N. J.

J. A. Cecce has been appointed assistant to the manager of purchases of the Consolidated Purchasing Agency for the American Short Line Railroad Association, with headquarters at Chicago.

J. T. Stephenson, formerly chief material inspector of the Southern Railway, has been appointed Washington sales agent for railroad supplies of the Newport News Shipbuilding & Dry Dock Company, Newport News, Va.

Edmund H. Jahnz has been appointed agent of the Mercury Manufacturing Company, Chicago, for its tractors and trailers in Philadelphia, Pa., and surrounding territory. Mr. Jahnz's office is at 2009 Market street, Philadelphia.

R. P. McCormick will have supervision of the sales activities of the Eastern district for the Pawling & Harnischfeger Company, Milwaukee. He will have offices at 30 Church street, New York, and 605 Stephen Girard building, Philadelphia, Pa.

D. P. Bennett, vice-president of the Pittsburgh Steel Company, Pittsburgh, Pa., has been elected president, and E. H. Bindley, a director, has been elected vice-president. Henry J. Miller was elected a director to succeed the late Willis T. McCook.

Henry Pearson, president of the Wason Manufacturing Company, Springfield, Mass., from 1906 to 1910, and vice-president since that time, died on November 27 at the age of 71. The company is a subsidiary of the J. G. Brill Company, Philadelphia, Pa.

H. N. Winner has been appointed general manager of the Garlock Packing Company, Palmyra, N. Y. Mr. Winner was formerly manager of the Philadelphia, Pa., branch of the Garlock Packing Company and later served as president and also as general manager of the Crandall Packing Company.

The Mahr Manufacturing Company, of Minneapolis, Minn., manufacturers of rivet forges, torches, furnaces and kindred oil-burning equipment, has moved its New York office from 56 Murray

street to larger quarters at 42 Murray street. Ray G. White is the district representative of the company at New York.

E. F. Piea, sales manager of the Mahr Manufacturing Company, with office located at 527 Commercial Trust building, Philadelphia, Pa., has had his territory extended so that it now comprises the state of Pennsylvania, with the exception of the northeastern portion, the states of Maryland and Delaware and the southern part of New Jersey.

David Newhall, of Philadelphia, Pa., has been appointed a sales representative in the steel car department of the Bethlehem Steel Company, with headquarters at Bethlehem. Mr. Newhall, before the war, was vice-president in charge of sales of the Geo. M. Newhall Engineering Company; this firm did an extensive railroad business in the East.

The Independent Equipment Corporation, with offices in the McCormick building, Chicago, has been organized for the purpose of repairing freight car equipment, leasing and repairing tank cars and manufacturing miscellaneous car parts. This company has bought the plant of the Goodwin Car & Manufacturing Company, located at Clearing, Ill.

The Linde Air Products Company, New York, recently started continuous operations in its new plant at Tulsa, Okla. Oxygen will be extracted from the air by the liquefaction process. The plant is also able to reclaim the nitrogen and separate the rare gases, argon and neon. C. A. Kennedy is operating superintendent. A Prest-O-Lite plant, for the manufacture of welding and cutting gas, is also planned for the same locality.

The Link-Belt Company, Chicago, has secured by purchase the Meese & Gottfried Company, of San Francisco, Los Angeles, Seattle and Portland. Meese & Gottfried Company, and its predecessors, have been manufacturers of power transmission machinery and distributors of conveying and transmission machinery on the Coast for many years. The new organization will be known as Link-Belt Meese & Gottfried Company, with headquarters at San Francisco and officers as follows: Charles Piez, chairman of the board; B. A. Gayman, president; Harold H. Clark, vice-president and sales manager; Leslie W. Shirley, treasurer, and Richard W. Yerkes, secretary.

The Electric Heating Apparatus Company, manufacturers of Multiple Unit and Heavy Duty electric furnaces, with general offices and works at Newark, N. J., has recently terminated an agreement with the Westinghouse Electric & Manufacturing Company for the exclusive sale of their special furnaces. The Electric Heating Apparatus Company has enlarged its sales and service department and has established a district office in Chicago. F. A. Hansen, formerly in charge of sales of electric furnaces in the Chicago territory for the Westinghouse Electric & Manufacturing Company, has been appointed district manager for the Electric Heating Apparatus Company in the Chicago territory, with office in the Marquette building, Chicago.

The Chain Belt Company, Milwaukee, Wis., manufacturers of Rex chain, transmission machinery and conveying equipment, formerly represented on the Pacific Coast by the Meese & Gottfried Company, San Francisco, Cal., has established direct factory branches and warehouses in Portland, Ore., and Seattle, Wash. The Northwest territory, with headquarters at Portland, will be in charge of Allen C. Sullivan. Don B. Catton will be the special sales representative for the Portland office. The Seattle and British Columbia territory will be handled by Wm. F. Nichols, of the Seattle office. The Portland office of the Chain Belt Company is located at 67-69 First street and the Seattle office at 1040 Sixth avenue, south. Large stocks are maintained at both Portland and Seattle.

The Industrial Works, Bay City, Mich., which was established in 1873, celebrated its fiftieth anniversary on October 13 at Bay City. The celebration included a sales conference of all representatives of the Industrial Works from all principal points of the United States, Canada, Cuba and South America. Another feature was a test of a 200-ton wrecking crane which had been built for the Norfolk & Western. At the banquet addresses were made by William L. Clements, president; C. R. Wells, secretary and treasurer, and Ernest B. Perry, general manager. The Industrial Works was started in 1873 with a working force of 30 men in a factory building 75 by 100 ft. The plant today covers an area of 29 acres of ground, and includes 59 buildings with 440,000

sq. ft. of floor area, 5 miles of railroad track and employs 1,800 men. The 59 buildings include a foundry and pattern, blacksmith, boiler, bucket, car, canopy, electrical, paint, pipe and machine shops, each of which is a complete unit. Besides, there is a pattern storage building, an employees' restaurant, a garage, and an office.

Dana R. Bullen, manager of the supply department of the General Electric Company, Schenectady, N. Y., has been appointed assistant vice-president on the staff of the vice-president in charge of sales of general apparatus and supplies. The lighting department has been changed to the central station department and the name of the power and mining department changed to the industrial department. C. W. Stone, manager of the former lighting department, continues as manager of the central station department. M. O. Troy, who was manager of the transformer sales department, has been appointed executive assistant manager of the central station department, with headquarters at Schenectady, and W. M. Stearns, formerly one of the assistant managers of the supply department, has been appointed assistant manager of the central station department. R. D. Mure, assistant manager of the former lighting department, has been appointed assistant manager of the central station department in charge of apparatus sales. F. G. Vaughn and present staff have been transferred to the central station department and continues in charge of the meter business of the company, Mr. Vaughn retaining the title of sales manager. W. S. Clark and present staff in charge of the company's wire and cable business, have been transferred to the central station department, and the railway supply section and present staff conducting the company's business on railway motor and control parts, railway line material and rail bonds, have been transferred from the supply department of which E. P. Waller is manager. Industrial heating devices, industrial control, mine locomotive and stationary motor repair parts, and fabroil, textolite and textolite gears sections of the supply department, have been transferred to the industrial department of which A. R. Bush, manager of the department under its former name of power and mining department, continues in charge. N. R. Birge, formerly one of the two assistant managers of the supply department, has been assigned to the staff of the president and will assist in supervision of associated manufacturing companies, being associated with D. C. Durland in this work.

H. E. Graham, manager of traffic and sales of the Pressed Steel Car Company and its subsidiary, the Western Steel Car & Foundry Company, with headquarters at New York, has resigned to become

vice-president in charge of sales of the Illinois Car & Manufacturing Company, with headquarters at Chicago. Mr. Graham was born on June 21, 1880, at Alliance, Ohio. He entered railway service in 1896 as a call boy in the operating department of the Pennsylvania at Pittsburgh, Pa. He was later a time clerk in the division superintendent's office and a bill clerk in the traffic department until 1898, when, upon the organization of the Pressed Steel Car Company, he entered its employ as chief clerk in the traffic department at Pittsburgh,

Pa. He held this position until 1905, when he was promoted to traffic manager, with the same headquarters, which position he held until 1920, when he was promoted to manager of traffic and sales, with headquarters at New York. He has held the latter position until his resignation to become vice-president in charge of sales of the Illinois Car & Manufacturing Company. Mr. Graham will take over the duties with the Illinois Car & Manufacturing Company on January 1.

The J. G. Brill Company, Philadelphia, on November 1 purchased the railroad motor coach division of the Service Motors, Inc., Wabash, Ind., with exclusive rights for the production and sale of the type of gasoline-driven rail car heretofore known as

the Service Model 55 Railroad Motor Coach. Cars of this type now in operation have completed one million and a half miles of service. While the Brill company has heretofore furnished only the bodies for these cars, it will now furnish the complete units without change in design. This type car will now be known as the Brill Model 55 Gasoline Car and will be handled by the automotive car division of the J. G. Brill Company, Philadelphia, with C. O. Guernsey, designer of this unit and formerly vice-president of Service Motors, Inc., as chief engineer; C. J. McPherson, sales manager; A. H. Hudson, formerly of Service Motors, Inc., as Eastern representative, and A. F. McCormick, formerly of Service Motors, Inc., as Southwestern representative. All renewal part business for cars of this type now in service and guarantees given by Service Motors, Inc., have also been taken over by the Brill company.

William F. Wendt, founder and former president of the Buffalo Forge Company, Buffalo, N. Y., and prominent for many years in local business and political affairs, died at his home in Buffalo on



William F. Wendt

Tuesday morning, October 30, at the age of 65. He was a brother of Henry Wendt, now president of the Buffalo Forge Company. Mr. Wendt was born in Buffalo. He continued as president of the company, which he was instrumental in starting, until 1916, when he retired. He was also president of the George L. Squire Manufacturing Company, the Buffalo Steam Pump Company and the W. F. Wendt Publishing Company, which published the American Blacksmith and La Hacienda, a magazine printed in Spanish and circulated in South

America. He retired from the latter company two years ago. Mr. Wendt was for some years prominently connected with Republican politics in his native city and was keenly interested in the betterment and advancement of civic and national affairs. While a keen student of political affairs, he never sought office for himself, although several times prominently mentioned and urged to become the candidate of the Republican party for mayor of Buffalo.

The Bradford Corporation

The Bradford Corporation has acquired all the capital stock and assets, and will assume all the obligations of the Bradford Draft Gear Company, the Republic Railway Equipment Company, Inc., and the Joliet Railway Supply Company. These properties will be operated as one unit after December 31, 1923.

The officers of the Bradford Corporation will be Horace Parker, president, New York; Burton Mudge, executive vice-president, Chicago; W. W. Rosser, vice-president, Chicago; Floyd K. Mays, vice-president, New York; A. F. Stuebing, chief engineer, New York; E. H. Barnes, secretary, New York; James H. Slawson, general manager, Chicago; Charles A. Carscadin, general sales manager, Chicago; William F. Hoffman, treasurer, New York; Arthur L. Pearson, assistant vice-president, Chicago. The executive committee will be Fred A. Poor, chairman; Horace Parker and Burton Mudge.

The Bradford Corporation will maintain executive offices at 25 West Forty-third street, New York City, and Railway Exchange building, Chicago, and sales offices in Washington, D. C., in charge of Harry F. Lowman; St. Louis, Mo., in charge of Walter C. Doering; San Francisco, Cal., in charge of E. F. Boyle; Mexico City, in charge of Joseph H. Cooper. The company will be represented in Canada by the Holden Company, Limited, of Montreal.

The company will sell and manufacture Bradford Draft Gears, Bradford Draft Arms, Chambers Throttle Valves, Huntoon Truck Bolsters and Huntoon and Joliet Brake Beams.



H. E. Graham

EQUIPMENT AND SHOPS

Locomotive Orders

THE CHICAGO & NORTH WESTERN has ordered a snow plow from the American Locomotive Company.

THE SOUTHERN PACIFIC has ordered 20, 0-6-0 switching type locomotives from the Lima Locomotive Works.

THE LOUISVILLE, HENDERSON & ST. LOUIS has ordered 1, 4-6-2 type locomotive from the American Locomotive Company.

THE TEMISKAMING & NORTHERN ONTARIO has ordered 3, 2-8-2 type locomotives from the Canadian Locomotive Company, Ltd.

THE LONG BELL LUMBER COMPANY has ordered 3, 70-ton geared locomotives from the Willamette Iron & Steel Works, Portland, Ore.

Passenger Car Orders

THE CANADIAN PACIFIC has ordered from the National Steel Car Corporation 15 steel frames for colonist cars.

THE WASHINGTON & LINCOLN has ordered a gasoline motor car from the Edwards Railway Motor Car Company.

THE LAURINBURG & SOUTHERN has ordered a gasoline motor car from the Edwards Railway Motor Car Company.

THE TORONTO, HAMILTON & BUFFALO has ordered 16 coaches and 6 smoking cars from the Canadian Car & Foundry Company.

THE MINNESOTA, DAKOTA & WESTERN has ordered one gasoline motor coach from the Oneida Manufacturing Company, Greenbay, Wis.

THE BIRMINGHAM & SOUTH EASTERN has ordered a gasoline motor car and trailer from the Edwards Railway Motor Car Company.

THE ST. LOUIS, KENNETT & SOUTHEASTERN has ordered a gasoline motor car and a trailer for this car from the Edwards Railway Motor Car Company.

THE TENNESSEE, KENTUCKY & NORTHERN has ordered from the Edwards Railway Motor Car Company, Sanford, N. C., a 32-ft. completely equipped motor car.

Freight Car Orders

THE GREAT NORTHERN will build 500 stock cars in its own shops.

THE SOUTHERN RAILWAY has placed an order for 1,000 steel underframes.

THE NEW YORK, CHICAGO & ST. LOUIS will build 15 caboose cars in its own shops.

THE LEHIGH & NEW ENGLAND has ordered 7 caboose cars from the Magor Car Corporation.

THE GREAT NORTHERN has ordered 100 underframes from the St. Paul Foundry Company.

THE ULSTER & DELAWARE has ordered 10 caboose cars from the Pressed Steel Car Company.

THE SOUTHERN RAILWAY has ordered 1,000 box cars from the American Car & Foundry Company.

THE ANACONDA COPPER MINING COMPANY has ordered 24 Ingoldsby type dump cars from the Koppel Industrial Car & Equipment Company.

Freight Car Repairs

THE MISSOURI PACIFIC will repair 100 gondola cars and 200 general service cars in its own shops.

THE CARNEGIE STEEL COMPANY will have repairs made to 200 steel hopper cars at the shops of the Greenville Steel Car Company; repairs made to 50 at the shops of the Federal Shipbuilding Company, and repairs made to 248 at the shops of the Koppel Car Repair Company.

Machinery and Tools

THE NEW YORK CENTRAL has placed an order for a 30-ton gantry crane.

THE PENNSYLVANIA RAILROAD has placed an order for a 6-ft. radial drill.

Shops and Terminals

WABASH.—This company has prepared plans for an addition to its enginehouse and shops at Moberly, Mo., to cost \$65,000.

SOUTHERN PACIFIC.—This company contemplates constructing new shop buildings and roundhouse facilities at Valentine, Tex.

CHICAGO & NORTH WESTERN.—This company will construct a storehouse at Casper, Wyo., at a cost of approximately \$14,000.

GULF COAST LINES.—This company plans the construction of a new enginehouse and repair shop at Brownsville, Tex., to cost \$100,000.

PENNSYLVANIA.—This company will construct a coal dock with unloading machinery and 60,000 ft. of storage track at Sandusky, Ohio, at a cost of \$342,000.

CHICAGO, MILWAUKEE & ST. PAUL.—This company plans the construction of a new enginehouse and shop at Monticello, Iowa, to cost approximately \$60,000.

ST. PAUL UNION DEPOT.—This company plans the construction of a roundhouse, adjoining the Union Depot yards, at St. Paul, Minn., to cost approximately \$75,000.

ERIE.—This company has awarded a contract to Roberts & Schaefer Company, Chicago, for the construction of a 200-ton steel automatic electric coaling station at Brier Hill, Ohio.

MISSOURI-KANSAS-TEXAS.—This company has awarded a contract to H. B. McCoy, Cleburne, Texas, for the construction of additions to its car shops at Denison, Texas, to cost approximately \$200,000.

NEW YORK, CHICAGO & ST. LOUIS.—This company will construct a new enginehouse and locomotive repair shop at Fort Wayne, Ind., on land recently purchased as a site for a new freight terminal and yard.

UNION PACIFIC.—This company has awarded a contract to the Unit Construction Co., San Francisco, Cal., for the construction of an enginehouse with a repair department, 75 ft. by 175 ft., at San Pedro Harbor, Los Angeles, Cal.

DENVER & RIO GRANDE WESTERN.—This company has placed an order with the Roberts & Schaefer Company, Chicago, for two standard N. & W. type electric locomotive cinder handling plants for installation at Soldier Summit, Utah.

THE TOLEDO, ST. LOUIS & WESTERN.—This company has awarded a contract to Bierd, Lydon & Grand Pre, Chicago, for the construction of a 27-stall engine house and other engine terminal facilities at Frankfort, Ind., to cost approximately \$300,000.

LAKE TERMINAL.—This company has awarded a contract to Roberts & Schaefer Company, Chicago, for the construction of a 200-ton reinforced concrete automatic electric coaling station and gravity sand plant with mechanical cinder handling plant at Lorain, Ohio.

MICHIGAN CENTRAL.—This company has awarded a contract to the Ellington-Miller Company, Chicago, for the construction of an 8-stall roundhouse, cinder pits, water and sewer lines and a number of small buildings in connection at Lansing, Mich., to cost \$125,000.

CHESAPEAKE & OHIO.—This company has awarded contracts to the Pittsburgh-Des Moines Steel Company, Pittsburgh, Pa., for the construction of water treating plants at Russell, Ky., Huntington, W. Va., Wheeler and Robbins, Ohio, and Whitesville, Taplin and Brushton, W. Va.

SOUTH AUSTRALIAN RAILWAYS.—A contract has been awarded to the Roberts & Schaefer Company, Chicago, for the construction of nine reinforced concrete and steel coaling stations, the largest to be of 300 tons' capacity including sand handling facilities. The Roberts & Schaefer Company will supervise the construction of each plant in Australia. The coaling stations will be located at Mile End, Peterborough, Adelaide, Karwonda, Port Adelaide, Port Erie, Wölseley, Cockburn and Port Lincoln.

PERSONAL MENTION

General

E. G. SANDERS has been appointed fuel supervisor of the Panhandle & Santa Fe, with headquarters at Amarillo, Tex.

C. R. BRUNELLE has been appointed fuel supervisor of the Eastern division of the Atchison, Topeka & Santa Fe, with headquarters in Emporia, Kan.

WILLIAM O. HAWKINS and Warren W. Saxton have been appointed traveling firemen on the Lehigh & Susquehanna division of the Central of New Jersey.

J. L. SMITH has been appointed superintendent of motive power of the Pittsburgh & West Virginia and the West Side Belt with headquarters at Pittsburgh, Pa., succeeding H. P. Anderson.

R. A. GREENE, supervisor of fuel and lubrication of the Chicago & Alton, with headquarters at Bloomington, Ill., has resigned to enter the service of the Galena Signal Oil Company as a special representative at Chicago.

DON NOTT, roundhouse foreman of the Chicago, Burlington & Quincy with headquarters at Galesburg, Ill., has been promoted to assistant master mechanic, with the same headquarters, succeeding H. H. Urbach, promoted.

EDWARD B. WHITMAN has been appointed superintendent of the Pennsylvania, with headquarters at Buffalo, N. Y. Mr. Whitman was born on November 6, 1888, at Washington, D. C., and attended St. Paul's School, Concord, N. H., and was graduated from Princeton University in 1910. He entered railway service on June 21 of the same year as a special apprentice at the Altoona shops of the Pennsylvania. In 1915 he was appointed motive power inspector and a year later was appointed assistant road foreman of engines. In 1917 he entered the army and served as a major and a commanding officer of the Fifty-ninth railway engineers of the American Expeditionary Force. Returning from military service, in 1919, he was appointed assistant master mechanic in the office of assistant to the general manager and then as master mechanic of the Wilmington shops, which position he was holding at the time of his recent promotion to division superintendent.



E. B. Whitman

FRED A. KLEIN has been appointed fuel supervisor of the Illinois division of the Atchison, Topeka & Santa Fe, with headquarters at Shopton, Iowa, and Leo W. Powell has been appointed fuel supervisor of the Missouri division.

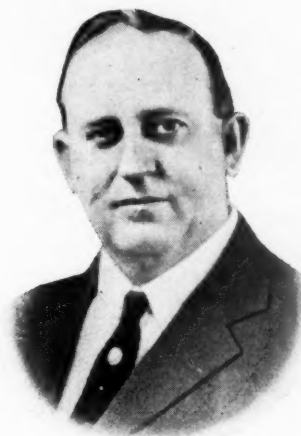
JOHN H. DALEY, master mechanic of the Boston division of the New York, New Haven & Hartford, has been appointed mechanical superintendent, Lines West and Central New England Railway, succeeding A. A. Harris, assigned to other duties.

J. E. BROWN, mechanical engineer of the St. Louis Southwestern, with headquarters at Pine Bluff, Ark., has been promoted to assistant superintendent of motive power, with the same headquarters, a newly created position. Mr. Miller will take over the duties formerly discharged by W. C. Stone, master car builder, who has resigned. E. J. Kueck has been appointed mechanical engineer, with headquarters at Pine Bluff, succeeding Mr. Brown.

SILAS ZWIGHT, acting general mechanical superintendent of the Northern Pacific, with headquarters at St. Paul, Minn., has been

promoted to general mechanical superintendent, with the same headquarters, succeeding H. M. Curry, who has retired. E. L. Grimm, mechanical engineer, with headquarters at St. Paul, has been promoted to assistant to the general mechanical superintendent, with the same headquarters, a newly created position. T. J. Cutler, acting mechanical superintendent, with headquarters at St. Paul, has been promoted to mechanical superintendent of the lines east of Paradise, Mont., with the same headquarters. G. F. Endicott, assistant master car builder, with headquarters at St. Paul, has been promoted to mechanical engineer, with the same headquarters, succeeding Mr. Grimm.

F. P. HOWELL has been appointed superintendent of motive power of the Atlantic Coast Line, with headquarters at Waycross, Ga. Mr. Howell was born on October 1, 1876, at Tarboro, N. C.



F. P. Howell

He entered railway service on April 11, 1896, as a machinist's apprentice on the Atlantic Coast Line. In April, 1902, he was appointed night roundhouse foreman at Rocky Mount, N. C., and in May, 1903, was promoted to gang foreman, holding that position until March, 1908, when he was appointed erecting shop foreman, with the same headquarters. In January, 1909, he was transferred to the Waycross shops in the same capacity and in July, 1917, was promoted to general foreman with the same headquarters. A year

later he was transferred to Savannah, Ga., as master mechanic of the Savannah and Charleston districts, serving in that capacity until October 15, 1920, when he was appointed shop superintendent at Waycross, which position he was holding at the time of his recent promotion to superintendent of motive power of the Second and Third divisions.

H. M. CURRY, general mechanical superintendent of the Northern Pacific, with headquarters at St. Paul, Minn., has retired from active duty after 43 years of continuous service with the company. Mr. Curry

was born on January 6, 1861, in Ogle county, Ill., and entered railway service in April, 1880, as a shop man and locomotive fireman on the Northern Pacific, being promoted to locomotive engineer in July, 1882. He was promoted to assistant road foreman of engines of the lines east of the Missouri river on December 1, 1891, and in December, 1898, was promoted to road foreman of engines. Mr. Curry was promoted to division master mechanic at Fargo, N. D., in November, 1901, and was transferred to



H. M. Curry

Staples, Minn., in December of the following year. He was promoted to general master mechanic of the lines east of Billings, Mont., in February, 1905, and in January, 1908, was given extended duties as general master mechanic to include the lines east of Paradise, Mont. In January, 1910, he was appointed general master mechanic of the lines east of the Missouri river. Mr. Curry was promoted to mechanical superintendent in May, 1911, and in August, 1920, was promoted to general mechanical superintendent.

WILLIAM J. BOHAN, assistant general mechanical superintendent of the Northern Pacific with headquarters at St. Paul, Minn., died in that city on October 27. Mr. Bohan was born on November 3, 1873, at Waukesha, Wis., and graduated from the College of Engineering of the University of Wisconsin in 1895. He entered railway service in September of that year as an inspector of electric signals on the Chicago, Milwaukee & St. Paul, three years later being promoted to electrician in charge of electric train lighting at the Western avenue yards in Chicago. In May, 1900, he was appointed electrician in charge of electric train lighting on the Northern Pacific at Portland, Ore., and in February, 1903, was promoted to electrician in the mechanical department. Mr. Bohan was promoted to chief draftsman in the mechanical department on May 1, 1905, and on January 1, 1909, was again promoted to electrical engineer. On January 1, 1910, he was promoted to mechanical engineer with headquarters at St. Paul, Minn., and was promoted to assistant mechanical superintendent in October, 1918. He was promoted to assistant general mechanical superintendent with headquarters at St. Paul in August, 1920, and was holding this position at the time of his death.

Master Mechanics and Road Foremen

A. C. RIDER has been appointed road foreman of engines of the Missouri-Kansas-Texas, with headquarters at Denison, Tex., succeeding J. H. Bush.

E. C. GORDON has been appointed assistant road foreman of engines of the Toledo division of the Pennsylvania, with headquarters at Toledo, Ohio, succeeding E. A. Burchiel, promoted.

M. KING has been appointed road foreman of engines of the Coast division of the Southern Pacific, with headquarters at San Francisco, Cal., succeeding H. L. Moore, who has been assigned to other duties.

B. P. JOHNSON, acting general master mechanic of the lines from Mandan, Mont., to Paradise, of the Northern Pacific, with headquarters at Livingston, Mont., has been promoted to general master mechanic, with the same headquarters. James Matheson, acting master mechanic of the Seattle division, with headquarters at Seattle, Wash., has been promoted to master mechanic, with the same headquarters.

J. P. EGAN has been appointed master mechanic on the Boston division of the New York, New Haven & Hartford, succeeding J. H. Daley. **D. P. Carey** has been appointed master mechanic of the Midland division. **J. B. Wyler** has been appointed to a similar position on the Hartford division, as have **L. G. Marette** on the Old Colony division and **O. H. Ritter** on the New Haven division. Mr. Marette succeeds C. U. Joy, assigned to other duties.

J. H. PAINTER, shop superintendent of the Atlantic Coast Line, with headquarters at Rocky Mount, N. C., has been appointed master mechanic of the Richmond, Norfolk and Fayetteville districts, with the same headquarters. **P. J. Meade**, master mechanic, with headquarters at Rocky Mount, has been transferred to the Wilmington district, with headquarters at Wilmington, N. C. **S. E. Porter**, general foreman, with headquarters at Port Tampa, Fla., has been appointed master mechanic, with headquarters at Waycross, Ga., succeeding C. A. White.

C. K. VAUGHT has been appointed assistant master mechanic of the Middle division of the Pennsylvania, succeeding J. G. Shaeffer, promoted. **H. H. Haupt** has been appointed master mechanic at Wilmington, Del., succeeding E. B. Whitman, promoted. **W. B. Porter** has been appointed assistant engineer of motive power in the office of the general superintendent of motive power of the Eastern region, succeeding Mr. Haupt. **G. S. West** has been appointed to a similar position on the Central Pennsylvania division, succeeding Mr. Porter. **D. K. Chase** has been appointed assistant master mechanic of the Meadows shops, succeeding Mr. West. **C. A. Wilson** has been appointed assistant master mechanic of the Trenton division, succeeding E. R. Buck, who has been transferred to a similar position.

Car Department

J. P. ELLIS has been promoted to general car foreman of the Missouri-Kansas-Texas, with headquarters at Waco, Tex.

O. D. CAREY has been appointed assistant foreman of the car shops of the Atchison, Topeka & Santa Fe at Argentine, Kan.

L. H. CONLEY has been transferred from Gallup, N. Mex., to Richmond, Cal., as car inspector foreman of the Atchison, Topeka & Santa Fe.

W. F. CROWDER has been appointed general car inspector of the Pere Marquette, with headquarters at Grand Rapids, Mich., succeeding J. McKenzie, deceased.

J. H. DOUGLAS, master car builder of the Wheeling & Lake Erie, with headquarters at Brewster, Ohio, has been transferred to Toledo, Ohio, with office in the Iron street shop yards.

FRANK ROEHR has been appointed master car repairer of the San Joaquin division of the Southern Pacific, with headquarters at Bakersfield, Cal., succeeding M. H. Warren, who has retired.

W. C. STONE, master car builder of the St. Louis-Southwestern, with headquarters at Pine Bluff, Ark., has resigned to become mechanical superintendent of the American Refrigerator Transit Company, with headquarters at St. Louis, Mo., succeeding T. E. Parker, resigned.

Shop and Enginehouse

E. D. COLON has been appointed shop efficiency engineer of the Pere Marquette, with headquarters at Detroit, Mich.

W. P. ISABEL has been promoted to material inspector in the machine shop of the Norfolk & Western at Roanoke, Va.

GEORGE WHITMORE has been appointed foreman of the old roundhouse of the Norfolk & Western at Williamson, W. Va.

C. E. KIMMERLING, machinist, has been promoted to assistant night foreman of the Norfolk & Western at Roanoke, Va.

W. A. BRULE has been appointed assistant roundhouse foreman of the Missouri-Kansas-Texas, with headquarters at Parsons, Kan.

JESS CAMPBELL has been appointed roundhouse and boiler foreman of the Missouri-Kansas-Texas, with headquarters at Wichita Falls, Tex.

E. C. RALPH has been promoted to night roundhouse foreman of the Missouri-Kansas-Texas, with headquarters at Muskogee, Okla., succeeding George Hays.

J. W. CHAPMAN, general roundhouse foreman of the Missouri-Kansas-Texas at Franklin, Mo., has been transferred to Parsons, Kan., succeeding J. Malsed.

J. MALSED, general roundhouse foreman of the Missouri-Kansas-Texas at Parsons, Kan., has been appointed mechanical inspector of the back shop at that point.

C. J. BAUMAN has been appointed supervisor of boiler inspection and maintenance of the New York, New Haven & Hartford, with headquarters at New Haven, Conn.

ARTHUR SMITH, assistant foreman of the locomotive paint shop of the Missouri-Kansas-Texas at Parsons, Kan., has been appointed general foreman of the paint shop at Waco, Tex.

E. B. WOOD, a graduate machinist from the San Bernardino, Cal., shops of the Atchison, Topeka & Santa Fe, has been appointed instructor of the Santa Fe apprentice school at Las Vegas, N. Mex.

Purchasing and Stores

W. R. CULVER has been appointed general storekeeper of the Pere Marquette, with headquarters at Grand Rapids, Mich., succeeding D. W. Roberts, who has resigned.

J. H. LAUDERDALE, assistant manager of the department of materials and supplies of the Railroad Administration, has succeeded M. J. Wise, manager, who has resigned to accept service elsewhere.

W. C. BOWER, assistant manager of purchases and stores of the New York Central Lines, with headquarters at New York, has been appointed manager of purchases and stores, with the same headquarters, succeeding S. B. Wight, promoted.

H. A. SMITH, general storekeeper of the Terminal Railroad Association of St. Louis, with headquarters at St. Louis, Mo., has been promoted to purchasing agent and general storekeeper, with the same headquarters, succeeding W. G. O'Fallon, who has resigned to engage in private business.

